STANDARD COTTON MILL PRACTICE AND EQUIPMENT

1919

THE NATIONAL ASSOCIATION
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THE COURSE OF EVENTS IN THE AMERICAN COTTON TRADE IN 1918

By Arthur Richmond Marsh
Editor of "The Economic World"

The year 1918 will undoubtedly go down in history as one of those years, occurring at intervals of a century or more, in which the future of mankind for generations to come is determined and in which consequently decisive changes are brought about in the contexture of human society with all its multitudinous interests, political, social and economic. The first three years of the great war in Europe, with their impressive vicissitudes and their seemingly frequent near approaches to a determination of the struggle, are now seen to have been only preliminary to the final act of the drama, in which at last the complex conflicting forces on either side were directed solely to the main issue and an irrevocable decision was arrived at. This final act of the world tragedy fell in 1918; and in the ultimate clash the very foundations of things seemed to be shaken. The year began with the last vast preparations of the mighty antagonists for what they intuitively perceived was to be the definitive trial of their strength; through most of its months the world was awaiting the outcome of the contest with alternate hope and doubt; it ended with the decision rendered and with all mankind endeavoring to accommodate itself to the changed order of human affairs, as well as to find ways and means of solving the huge problems, financial, economic and other, which the war itself had given rise to and had left behind for settlement.

It is self-evident that no department of the world's economic interest, no branch of trade or industry anywhere, could expect to escape being affected—and that profoundly—by both the direct and the indirect influences of such a world-embracing struggle *à l'outrance* as that which reached its climax in 1918, or by the repercussions of the termination of the struggle. The American cotton trade is, of course, no exception to this rule. Like all the other essential branches of American trade, it had, even in the years before the United States entered the war, come to be dominated to a very large extent by the financial and economic conditions begotten of the struggle. On the one hand, its freedom of action had been more and more restricted as the war progressed, first, by the blockade of the Central Powers; then, by the difficulties occa-

sioned by the German submarine campaign and the withdrawal of ocean tonnage for military and naval uses; again, by the ever increasing disparities of international exchange, and, finally, by the regulations of one and another kind with which the Entente Governments found themselves compelled to surround not only the commerce in cotton itself but also the operations of the cotton industry in their respective countries and the merchandising of the products of this industry. On the other hand, the cotton trade had experienced the stimulation—and the commercial uncertainty also—of the world-wide inflation of the prices of all commodities, and in addition the particular stimulation of the keen demand for cotton itself due to the manifold war uses of cotton products and the consequent pressure upon the cotton industry everywhere of a demand for these products continually in excess of the effective capacity of the manufacturing establishments left available by the vicissitudes of the war. Furthermore, the trade had been forced to modify in important respects its traditional and normal methods and processes in the merchandising and distribution of cotton, owing to the incessant shifting of the emphasis of demand as between the different grades and qualities of the commodity in which it dealt. The old rules of the trade, its former criteria in the conduct of its business, had of necessity been largely discarded; and its operations had become correspondingly what the philosophers would call pragmatic,—that is, subject to the test of day-to-day experience as it went along.

EFFECT OF GOVERNMENT DEMAND

All this had come about by the time the United States became one of the belligerents and had set about bringing its vast resources to bear in order that the war might be both justly and speedily concluded. But with the entry of the United States into the great struggle, as the country gathered its resources of every kind for the accomplishment of the task it had appointed for itself, the stress and strain of the conditions just described became still more severe for the cotton trade. One of the earliest economic effects of American belligerency was a truly prodigious demand from the American Government for a wide variety of the products of cotton for the immense armies and the great fleet that were planned for. The cotton trade had never before known a demand from a single source even remotely approaching this. And at the beginning of 1918 this demand was running at full tide, not only insatiably drawing upon the production of the American cotton mills at the time but also contracting for a very large part of their production for

an indefinite period in the future. Supplying the requirements of the civilian population of the country quickly became of quite secondary concern to the industry—and this at a time when both the agricultural and the industrial classes were enjoying an unprecedented income and were eager to spend this income freely in the purchase of cotton goods, as well as of other articles of necessity and luxury, always desired by these classes but never before attainable by them in satisfying quantities. A natural consequence of this posture of affairs was that prices for cotton goods in the United States had risen to levels higher than the present generation had ever before known; while in Europe, unable to procure cotton freely and with the productive capacity of the mills greatly reduced by war conditions, as well as in the countries of the world that rely largely upon importations for their supply of cotton goods, the prices asked and obtained for these goods had become almost unbelievable, in comparison with anything experienced in recent years.

UNUSUAL CONDITIONS IN 1918

When the American cotton trade entered on the business of 1918, therefore, it had to reckon with price-enhancing influences of the most powerful character, yet with ever-present uncertainty as to the scope and duration of these influences—seeing that the end of the war must sometime be reached—and with all the perplexities arising from the extraordinarily uneven distribution of the supply of cotton in the world's markets, due to the effects of the war upon the supply of ocean tonnage for commercial uses, upon the movement of the international exchanges and upon the financial situation of the several belligerent countries. This unevenness of the distribution of the supply of cotton, moreover, was of special importance to the cotton trade in the United States, because the very fact that this is the greatest cotton-producing country in the world brought it about that the under-supply in foreign countries had as its correlative a continuous over-supply here. It may be said, then, that the American trade, from the very beginning of 1918, has been subjected to very strong opposite demand and supply and price-determining forces, whose clash has produced violent upward and downward movements of the markets and has made irregularity and incalculability the rule rather than the exception in the transaction of the business. As an illustration of this statement it may be mentioned that there have occurred more than once during the year price fluctuations more extensive (in cents per pound) than the entire average price for cotton in the United States during the decade preceding the war.

OPENING AND CLOSING PRICES

In view of what has just been said, it appears to be a somewhat curious fact that the net result of the 1918 price variations for cotton in the United States should have been virtually nil. By this is meant that the year ended with the current prices for cotton future contracts on the New York and New Orleans Cotton Exchanges only insignificantly different from those obtaining when the year opened,—*i.e.*, approximately 30 cents per pound; while the differences in the prices of the more desirable grades and qualities of "spot" cotton, though somewhat greater than those in the prices of future contracts, were remarkably small in proportion to the total price. Both at the beginning and at the end of 1918, the better grades of white cotton commanded unusual premiums over future contracts, with these premiums rather larger in December than in January; but this change in the "basis" was after all not sufficient to render inaccurate the general statement that there was virtually no net alteration for the year in the market level for "spot" cotton in this country. Speaking in round terms, it is correct to say that all the vicissitudes of the twelvemonth produced no real net change in the market value of actual cotton in the United States proper (except for the lower and less desirable grades, which declined sharply in price when compared with the better grades of white cotton). And this market value was approximately three times as great as the average market value of similar cotton for the ten years before the war, and quite twice as great as the average market value in those pre-war years in which notably short crops were produced.

WIDE FLUCTUATION DURING YEAR

Despite this almost identity of cotton prices in the United States at the beginning and at the end of 1918, however, the intermediary upward and downward price movements of the year were both numerous and extraordinarily wide, as has been indicated above. And since the cotton trade is naturally more concerned with prices from day to day than with the net price outcome of so long a period of time as a year, it is perhaps well as a matter of record to review briefly the price fluctuations of the twelvemonth here under consideration. In the last days of 1917 the quotations for future contracts on the New York Cotton Exchange were at the approximate level of 30½ cents per pound, while the local quotations for middling cotton "on the spot" in the same market were from 1 cent to 1½ cents per pound higher. Upon the

first trading day of 1918, prices in New York began to advance; and with the customary temporary reactions—though much more sudden and extensive than in the pre-war days—the advance thus initiated continued until the first week in April, when the prices of the nearer future deliveries had risen above $34\frac{1}{2}$ cents per pound, and middling cotton "on the spot" was quoted as high as 36 cents per pound. For the moment, indeed, there was much to be said in favor of the general belief that it would prove to be a matter of a few weeks only before future contracts and actual cotton in New York would reach 40 cents per pound and perhaps a considerably higher figure. "The tree never grows quite to the heavens," however, and at the very moment when the market seemed strongest and most buoyant, it suddenly became apparent that the vast ocean tonnage diverted from commercial uses for the purpose of conveying the American military forces to Europe could have no other result for the cotton trade than a most serious interruption of cotton exports from the United States. The markets halted and after a little hesitation began to decline, at first slowly, but soon with almost precipitate rapidity—the break in prices being made more severe by the receipt of excellent reports from the South with regard to the cotton acreage in prospect for the new season of 1918-1919 and the good start the recently planted crop was making. Within the single month of April prices for cotton future contracts in New York fell no less than $8\frac{1}{2}$ cents per pound, though it was observed that even in New York the drop in the price of middling cotton "on the spot" was substantially less, while in the Southern spot markets it was less than one-half as great.

SPOT COTTON RESISTS DEPRESSION

By the end of May, the downward movement in the futures markets had proceeded still further to such an extent that a net price loss of more than 11 cents per pound had been accomplished in barely two months—though once more the failure of the quotations for spot cotton in New York and the South to follow, or anywhere near follow, the quotations for future contracts was a most striking feature of the situation. It was, indeed, this resistance of the spot cotton markets to the price-depressing influences which were making themselves felt on the great cotton exchanges that finally turned the tide in the futures markets, presenting the trade with the other side of the picture. By the end of June there had come about a recovery in the prices of future contracts equal to more than one-half of the total amount of the previous

decline; and, what was still more impressive, quotations for spot cotton everywhere had risen quite as fast and as extensively as those for future contracts. In other words, despite the restriction of cotton exports from the United States and the consequent piling up of stocks at the American ports and interior towns, as well as upon the farms themselves, the known ability of the manufacturers to pay many cents per pound more for their raw material than they were actually called upon to pay sufficed to restore cotton prices almost to their former high level—and this in the face of what in June promised to be an excellent new crop.

While this was true of the cotton remaining from the crop of 1917 and from previous crops, it should be remembered that until the latter part of July the so-called "new crop" deliveries on the American exchanges commanded very much lower prices than did actual cotton on "old crop" deliveries. Thus October contracts sold on the New York Cotton Exchange well below 25 cents per pound for many months through the spring and early summer of 1918, the impression being well-nigh universal that the promise of the new crop made even this price considerably higher than was actually warranted by the prospective demand and supply situation for 1918–1919.

MIDSUMMER PRICES HIGHEST SINCE 1865

As midsummer approached, however, this prospect of the new crop began to change for the worse with startling rapidity, especially in the States west of the Mississippi River. Crop deterioration of the most serious kind set in by reason of a lack of adequate summer rainfall—the need for good summer rains being imperative, owing to the failure of the rainfall during the preceding winter to provide the customary subsoil moisture in the States mentioned. The profound alteration in the outlook for the supply of American cotton in 1918–1919 was reflected by the distressingly low estimate of the condition and expectancy of the crop which was issued by the Department of Agriculture in early August. As soon as this estimate was issued it was at once clear to the trade, both in this country and abroad, that the world had ahead of it in all probability the fourth of a succession of extremely short crops of American cotton, it having been the experience of the pre-war years that even three short crops in succession constitute one of the rarest happenings in the domain of cotton. As was to have been expected, prices immediately began to rise irresistibly and between the first week in August and the first week in September the advance had carried October contracts in New York to 37½ cents per pound and the New York

quotation for middling cotton "on the spot" to within five market points of $38\frac{1}{4}$ cents per pound,—these prices being not far from 15 cents per pound higher than those commanded by the same October contracts in New York in the previous May. Moreover, these prices were the highest for which American cotton had been bought and sold in New York since 1865, the last year of the Civil War.

ALLIED VICTORIES INFLUENCE MARKET

At the very time these extraordinarily high prices were obtaining, however, an unexpected new influence of the most powerful and far-reaching kind was coming into play in the entire domain of commodity prices,—cotton prices as well as the rest. This influence proceeded from the continued victories of the Allied armies in Europe and Asia, from which it was easy to deduce an earlier termination of the war than even the most confident believers in the Allied cause had dared to hope for. As the German armies were perceptibly weakened from week to week, and almost from day to day, by the hammer-blows of the Entente military and naval forces, the unavoidable feeling grew stronger and stronger in the cotton trade that with the end of the war there must be some readjustment of prices as a result of the vast diminution in the requirements of the belligerent Governments for cotton and the products of cotton. The older theory, so widely accepted two years ago, that the termination of hostilities would find the world at large bare of cotton and cotton goods, and eager to secure fresh supplies of the same at almost any price, was very generally abandoned as merchants and manufacturers were brought face to face with the imminent cancellation of Government contracts, the readjustment of the cotton industry to the demands of the civilian population alone, and the possibility that important masses of consumers in all countries would be compelled to curtail their purchases, because no longer earning themselves the munificent profits and wages of war-time. Throughout September and October, therefore, the impending decisive victory of the Allies cast its shadow before in the domain of cotton, as in so many other directions. The predicted further advance of the price of cotton to higher levels than ever before since the war began failed of realization; on the contrary, the cotton markets displayed a distinct inclination to decline. Nor was this tendency really stayed by the signing of the armistice with Germany on November 11th. In fact, many think that only the interposition of the American Government, which for a time prohibited short selling or selling for foreign account, served to pre-

vent a general debacle both in the futures markets and in the markets for cotton "on the spot." At any rate, by the middle of November prices were again 10 cents per pound below those obtaining in early September, and it was by reason of an upward reaction from this lower level that prices in the United States were brought back towards the end of the year to approximately the height at which they had stood at the end of 1917. In Great Britain, on the other hand, and to some extent in the countries of Continental Europe, the easing off of ocean freight rates and the virtual disappearance of marine war-risk insurance charges, due to the cessation of submarine warfare, had by the end of 1918 produced so considerable a reduction in the cost of importing cotton from the United States and other cotton-producing countries that the price of cotton was substantially lower at the end of 1918 than it had been at the beginning of the year.

CONDITIONS AND PROSPECTS OF TODAY

Although it was the intention of this article to survey briefly the happenings in the American cotton trade during the last calendar year, it may not be out of place to say a word of the conditions and prospects of the trade as they now are. At the time of this writing, a fortnight after the turn of the year, the American and foreign cotton futures markets are displaying once more the same tendency towards lower prices which was manifested during the last weeks of the war and immediately after the submission of Germany to the Allies. In fact, since January 1, 1919, the decline on the great cotton exchanges has been a very substantial one, and contracts for the future delivery of cotton are cheaper than they have been since September, 1917. This, however, is not true of actual cotton of the better grades and qualities, whether in the South or elsewhere. An extraordinary disparity exists at the moment, indeed, between the prices manufacturers and exporters must pay for the cotton they chiefly desire and the theoretically parallel prices ruling for contracts on the exchanges. It is probably the expectation of the great majority of the trade, whether merchants or manufacturers, that this disparity will in the comparatively near future be resolved by a lessening of the courage of the holders of desirable spot cotton and a consequent large reduction in the price at which the holders will sell freely. In all financial and commercial circles in this country and abroad the opinion is now almost an article of faith that the end of the war has necessarily brought with it a large-scale price readjustment for all the major commodities, and this in a downward direction. Those concerned with cotton for the most part share this

belief and are very skeptical of the success of any that are willing to act upon the opposite assumption.

THE PROBLEM OF THE PRESENT

This diagnosis of the economic and social situation in which the world is left by the termination of the war may, of course, prove in the event to be entirely correct—who shall venture, in the great obscurity in which we find ourselves, to assert the contrary with conviction? Yet who, on the other hand, can be certain that a readjustment of so great a scope can be accomplished with the speed that the financial and commercial community appears confidently to expect. It is true, to be sure, that for the time being hesitation is the order of the day among those who are called by the economists "enterprisers" or "entrepreneurs"—the leaders of business, the bearers of the risks of business, the initiators of the major movements of business. It still remains true, however, that a monetary inflation whose like the world has never seen exists as a present fact and cannot possibly be disposed of out of hand; and, if there be any truth whatever in the theory of the relation of prices to the volume of money, the sustaining influence of this monetary inflation upon all prices, the price of cotton among them, will be felt for many a long month, and perhaps year, to come. Besides this monetary inflation, it were unwise to forget the fact that enormous numbers of agricultural and industrial workers, in this and other countries, are still obtaining returns from their labor out of all proportion to their pre-war earnings. Even though unemployment increase as a result of the cessation of war production and the return of armies to their homes, the general work of the world must go on and a very long time must elapse before the remuneration of those who work declines substantially from what it now is. With the passage of the years, no doubt, the necessary readjustments will be accomplished; but it seems idle to expect that they will come about within a few short months. And in the transition period there will certainly be many and bitter disappointments for those who forget that this is a case of making haste slowly. It were therefore the part of wisdom for all who are concerned with the cotton trade and industry to take carefully and constantly into account the facts, first, that we still have with us monetary inflation in as yet but insignificantly diminished volume, and, second, that the purchasing power of the producing classes in all countries will but slowly be lessened, either by unemployment, grievous though this may be for large numbers of individuals, or by decreases in the income of such workers as have an established and necessary place in the economic whole.

PRODUCTION, CONSUMPTION, EXPORTS, AND NET IMPORTS OF RAW COTTON, FOR THE UNITED STATES: 1878–1918.

(United States Census Data.)

Season Ending	Cotton Production (Exclusive of Linters)		Consumption of Cotton and Linters (equivalent 500-pound bales)	Exports of Domestic Cotton (equivalent 500-pound bales)	Net imports (equivalent 500-pound bales)	Percentage of exports to total crop
	Running bales, counting round as half bales	Equivalent 500-pound bales, gross weight				
1918	11,248,242	11,302,375	7,707,721[1]	4,476,124[1]	221,216[2]	40[1]
1917	11,363,915	11,449,930	7,721,354	5,963,682	288,486	52
1916	11,068,173	11,191,820	7,326,598	6,405,993	420,995	57
1915	15,905,840	16,134,930	6,087,338	8,931,253	363,595	55
1914	13,982,811	14,156,486	5,942,808	9,256,028	265,646	65
1913	13,488,539	13,703,421	5,867,431	9,199,093	225,460	67
1912	15,553,073	15,692,701	5,400,005	10,681,332	220,268	68
1911	11,568,334	11,608,616	4,713,126	8,025,991	231,191	69
1910	10,072,731	10,004,949	4,759,364	6,491,843	151,395	65
1909	13,086,005	13,241,799	5,198,963	8,889,724	165,451	67
1908	11,057,822	11,107,179	4,493,028	7,779,508	140,869	70
1907	12,983,201	13,273,809	4,974,199	8,825,236	202,733	66
1906	10,495,105	10,575,017	4,877,465	6,975,494	133,464	65
1905	13,451,337	13,438,012	4,523,208	9,057,397	130,182	67
1904	9,819,969	9,851,129	3,980,567	6,233,682	100,298	63
1903	10,588,250	10,630,945	4,187,076	6,913,506	149,113	65
1902	9,582,520	9,509,745	4,080,287	6,870,313	190,080	72
1901	10,102,102	10,123,027	3,603,516	6,806,572	116,610	67
1900	9,393,242	9,345,391	3,687,253	6,167,623	134,778	66
1899	11,189,205	11,435,368	3,672,097	7,626,525	103,223	67
1898	10,897,857	10,985,040	3,472,398	7,811,031	105,802	71
1897	8,532,705	8,515,640	2,841,394	6,124,026	114,712	72
1896	7,161,094	7,146,772	2,499,731	4,761,505	112,001	67
1895	9,901,251	10,025,534	2,983,665	6,961,372	99,399	69
1894	7,493,000	7,433,056	2,300,276	5,307,295	59,405	71
1893	6,700,365	6,658,313	2,415,875	4,485,251	85,735	67
1892	9,035,379	8,940,867	2,846,753	5,896,800	64,394	66
1891	8,652,597	8,562,089	2,604,491	5,850,219	45,580	68
1890	7,472,511	7,472,511	2,518,409	4,928,921	18,334	66
1889	6,938,290	6,923,775	2,309,250	4,730,192	15,284	68
1888	7,046,833	6,884,667	2,205,302	4,519,254	11,983	66
1887	6,505,087	6,314,561	2,049,687	4,301,542	7,552	68
1886	6,575,691	6,369,341	2,094,682	4,200,651	8,270	66
1885	5,682,000	5,477,448	1,687,108	3,783,319	7,144	69
1884	5,713,200	5,521,963	1,813,865	3,733,369	11,247	68
1883	6,949,756	6,833,442	2,038,400	4,591,331	4,716	67
1882	5,456,048	5,136,447	1,849,457	3,376,521	3,261	66
1881	6,605,750	6,356,998	1,865,922	4,453,495	5,447	70
1880	5,755,359	5,466,387	1,500,688	3,742,752	7,578	69
1879	5,074,155	4,745,078	1,457,266	3,290,167	5,040	69
1878	4,773,865	4,494,224	1,458,667	3,197,439	5,046	71

[1] Running bales. [2] Gross imports.

ACREAGE OF COTTON HARVESTED IN THE UNITED STATES, BY STATES: 1909–1918.

(United States Department of Agriculture Data.)

State	Thousands of Acres									
	1918‡	1917	1916	1915	1914	1913	1912	1911	1910	1909
Total . . .	37,073	33,841	34,085	31,412	36,832	37,089	34,283	36,045	32,403	32,044
Alabama	2,622	1,977	3,225	3,340	4,007	3,760	3,730	4,017	3,560	3,731
Arkansas	2,922	2,740	2,600	2,170	2,480	2,502	1,991	2,363	2,238	2,153
California	194	136	*	*	*	*	*	*	*	*
Florida . . .	167	183	191	193	221	188	224	308	257	263
Georgia . . .	5,432	5,195	5,277	4,825	5,433	5,318	5,335	5,504	4,873	4,883
Louisiana .	1,553	1,454	1,250	990	1,299	1,244	929	1,075	975	957
Mississippi . .	3,264	2,788	3,110	2,735	3,054	3,067	2,889	3,340	3,317	3,400
Missouri † . . .	267	209	210	150	212	126	112	141	109	106
North Carolina .	1,609	1,515	1,451	1,282	1,527	1,576	1,545	1,624	1,478	1,274
Oklahoma . . .	3,161	2,783	2,562	1,895	2,847	3,009	2,665	3,050	2,204	1,977
South Carolina .	2,995	2,837	2,780	2,516	2,861	2,790	2,695	2,800	2,534	2,557
Tennessee . . .	926	882	887	772	915	865	783	837	765	788
Texas	11,910	11,092	11,400	10,510	11,931	12,597	11,338	10,943	10,060	9,930
Virginia	51	50	42	34	45	47	47	43	33	25

* Included in Missouri. † Includes statistics for other states not named. ‡ June estimate of area planted.

COTTON PRODUCTION, POUNDS PER ACRE, BY STATES: 1906–1918.

(United States Department of Agriculture Data.)

	1917	1916	1915	1914	1913	1912	1911	1910	1909	1908	1907	1906	1905
United States .	160	156	157	170	209	182	191	208	171	154	195	178	203
Alabama . . .	125	110	79	146	209	190	172	204	160	142	179	169	165
Arkansas . .	170	162	209	180	196	205	190	190	175	153	215	195	215
California .	242	275	400	380	500	500	450	390	335	—	—	—	—
Florida .	100	105	105	120	175	150	113	130	110	110	112	115	95
Georgia . .	173	173	165	189	239	208	159	240	173	184	190	190	165
Louisiana . .	210	218	170	165	165	170	193	170	120	130	145	210	272
Mississippi	155	153	125	167	195	204	173	172	182	157	233	228	215
Missouri . .	190	175	225	240	270	286	260	360	285	271	340	275	285
North Carolina	194	187	215	260	290	239	267	315	227	210	211	205	201
Oklahoma . . .	165	150	154	162	212	132	183	160	200	147	143	200	217
South Carolina	208	205	160	215	255	235	209	280	216	210	219	215	175
Tennessee . . .	130	115	206	188	200	210	169	257	207	158	218	190	180
Texas . .	135	135	157	147	184	150	206	186	145	125	196	130	225
Virginia . . .	180	170	310	225	265	240	250	330	212	190	210	190	185

ESTIMATED VALUES OF COTTON AND COTTON SEED PRODUCED AND OF COTTON EXPORTED.

(United States Census Data.)

Season ending	Value of Cotton Produced	Value of Cotton Seed Produced	Total Value of Cotton Crop	Value of * Cotton Exported
1918	$1,532,690,000	$333,550,000	$1,866,240,000	$665,024,655
1917	994,060,000	259,070,000	1,253,130,000	543,100,542
1916	627,940,000	167,900,000	795,840,000	374,186,247
1915	591,130,000	128,950,000	720,080,000	376,217,972
1914	885,350,000	141,350,000	1,026,700,000	610,475,301
1913	786,800,000	117,330,000	904,130,000	547,357,195
1912	749,890,000	119,800,000	869,690,000	565,849,271
1911	820,320,000	142,860,000	963,180,000	585,318,869
1910	688,350,000	123,740,000	812,090,000	450,447,243
1909	588,810,000	92,420,000	681,230,000	417,390,655
1908	613,630,000	87,330,000	700,960,000	437,788,202
1907	640,310,000	81,340,000	721,650,000	481,277,797
1906	556,830,000	75,470,000	632,300,000	401,005,921
1905	561,100,000	90,930,000	652,030,000	379,965,014
1904	576,500,000	84,050,000	660,550,000	370,811,246
1903	421,688,000	80,209,000	501,897,000	316,180,429

* Fiscal years.

WORLD'S PRODUCTION OF COTTON: 1914–1918.

(Commercial and Financial Chronicle Estimates.)

Country	500-Pound Bales produced for the Year ending July 31				
	1918	1917	1916	1915	1914
Total	17,164,650	17,090,099	17,371,166	19,578,954	20,914,660
United States	11,547,650	12,670,099	12,633,960	14,766,467	14,494,762
India	3,950,000	4,100,000	3,625,034	3,337,000	4,592,149
Egypt	1,167,000	950,000	892,172	1,235,487	1,439,802
Other countries	500,000	270,000	220,000	240,000	387,947

PRODUCTION, CONSUMPTION, AND EXPORTS OF SEA-ISLAND COTTON: 1903-1918.

(Commercial and Financial Chronicle Data.)

Season Ending	Production				American Consumption	Exports	
	Total	Florida	Georgia	So. Carolina		Total	Gt. Britain
1918	83,140	33,755	42,414	6,971	66,000	2,420	637
1917	114,081	43,080	67,506	3,495	113,372	2,173	1,478
1916	84,521	30,367	47,943	6,211	80,032	4,363	2,624
1915	77,812*	35,686	36,630	5,488	73,313	5,846	1,711
1914	83,857	34,000	39,384	10,473	77,374	17,646	12,359
1913	68,163	20,780	39,008	8,375	44,862	13,195	8,528
1912	122,866	60,902	56,824	5,140	95,588	27,483	19,667
1911	89,601	35,190	41,073	13,338	62,825	22,925	16,505
1910	96,539	39,261	42,781	14,497	67,562	29,428	24,744
1909	102,469	42,126	45,171	15,172	77,544	25,808	18,241
1908	85,191	41,863	30,590	12,738	50,300	32,383	22,748
1907	56,108	23,411	24,653	8,044	36,101	20,489	15,200
1906	116,962	30,378	72,872	13,712	78,923	39,262	30,034
1905	99,663	37,873	49,696	12,094	62,556	38,402	30,832
1904	76,709	28,005	39,345	9,359	43,578	31,320	24,188
1903	102,634	27,686	62,451	12,497	50,524	54,082	44,354

* Includes 8 bales grown in Texas.

EGYPTIAN COTTON: ACREAGE AND PRODUCTION: 1904-1918.

Season	Thousands * of Acres	Thousands † of Pounds	Season	Thousands of Acres	Thousands of Pounds
1918-19	1,368 ‡	—	1910-11	1,709	750,158
1917-18	1,744	—	1909-10	1,661	495,326
1916-17	1,722	507,750	1908-09	1,706	668,699
1915-16	1,233	456,168	1907-08	1,667	716,593
1914-15	1,825	628,361	1906-07	1,566	688,336
1913-14	1,792	761,110	1905-06	1,630	585,373
1912-13	1,791	746,135	1904-05	1,494	625,339
1911-12	1,779	735,367	1903-04	1,386	644,711

* Ministry of Agriculture data. † Liverpool Cotton Association data. ‡ Preliminary estimate.

PRODUCTION OF COTTON, BY STATES: 1900–1917.

(Linters excluded. Thousands of running bales, except that round bales are counted as half bales. United States Census Data.)

State	1917	1916	1915	1914	1913	1912	1911	1910	1909	1908	1907	1906	1905	1904	1903	1902	1901	1900
	Year of Planting																	
United States .	11,248	11,364	11,068	15,906	13,983	13,489	15,553	11,568	10,073	13,086	11,058	12,983	10,495	13,451	9,820	10,588	9,583	10,102
Alabama . . .	520	553	1,026	1,732	1,484	1,328	1,695	1,192	1,040	1,332	1,113	1,241	1,228	1,451	987	966	1,113	1,029
Arkansas .	954	1,103	790	999	1,038	771	908	798	698	996	752	894	590	901	716	949	712	801
Florida	48	51	55	91	67	59	94	67	62	71	57	61	79	88	59	67	57	56
Georgia . . .	1,885	1,852	1,938	2,723	2,346	1,813	2,794	1,812	1,850	1,977	1,860	1,633	1,725	1,963	1,306	1,476	1,374	1,257
Louisiana . . .	630	441	337	452	437	375	381	247	258	467	662	955	512	1,084	818	867	834	705
Mississippi . .	886	800	926	1,218	1,252	1,004	1,169	1,212	1,073	1,620	1,443	1,483	1,168	1,774	1,411	1,423	1,253	1,037
North Carolina	657	694	737	970	838	906	1,126	753	634	684	638	611	653	750	555	568	450	508
Oklahoma . .	955	813	622	1,233	842	1,005	1,017	920	553	689	849	872	660	796	457	531	371	346
South Carolina	1,267	971	1,174	1,560	1,419	1,224	1,692	1,211	1,137	1,216	1,164	913	1,112	1,193	814	948	732	780
Tennessee . .	239	378	296	372	367	267	430	321	241	334	266	293	269	320	241	307	195	215
Texas	3,042	3,563	3,069	4,390	3,773	4,645	4,107	2,950	2,469	3,627	2,208	3,958	2,433	3,062	2,406	2,428	2,448	3,329
All other . . .	165	145	99	165	120	90	139	85	58	73	46	68	57	69	50	59	44	39

TOTAL IMPORTS OF COTTON, BY COUNTRIES OF PRODUCTION: 1913–1918.

(Equivalent 500-pound bales. Bureau of Foreign and Domestic Commerce.)

Produced in	Imports for Year Ending July 31				
	1918	1917	1916	1915	1914
Total	220,596	291,957	437,574	382,286	260,988
Egypt	113,961	199,892	350,796	252,373	138,579
China	38,817	36,063	35,792	25,631	20,772
Peru	19,692	11,069	10,909	10,353	12,627
India	7,096	3,860	4,214	7,845	7,849
Mexico	37,272	32,858	30,098	85,180	80,285
All other	3,758	8,215	5,765	904	876

WORLD'S CONSUMPTION OF COTTON: 1914–1918.

(Commercial and Financial Chronicle Estimates.)

Country	500-Pound Bales consumed for Year ending July 31				
	1918	1917	1916	1915	1914
United States—North	2,991,400	3,193,392	3,238,748	2,768,415	2,701,479
United States—South	4,182,546	4,237,296	3,870,971	3,037,280	2,978,533
Total United States	7,173,946	7,430,688	7,109,719	5,805,695	5,680,012
Great Britain	2,900,000	3,000,000	4,000,000	3,900,000	4,300,000
Continent	3,000,000	4,000,000	5,000,000	5,000,000	6,000,000
East Indies	1,775,000	1,764,000	1,723,011	1,648,468	1,680,210
Japan	1,850,000	1,774,960	1,747,382	1,538,210	1,521,582
Other countries	844,560	1,195,915	763,640	854,296	676,372
World Total	17,543,506	19,165,563	20,343,752	18,746,669	19,858,176

CONSUMPTION OF COTTON, BY STATES, 1911–1918.

Running bales. Statistics for 1915-16-17-18 relate to the 12 months ending July 31, and, those for prior years to the 12 months ending August 31, United States Census Data.

State	Year							
	1918	1917	1916	1915	1914	1913	1912	1911
United States	6566	6789	6398	5597	5577	5483	5129	4498
Alabama	375	391	346	297	287	294	263	233
Connecticut	138	146	144	133	135	127	125	115
Georgia	854	907	798	660	632	631	549	475
Maine	185	187	194	176	181	175	167	152
Massachusetts	1459	1459	1463	1283	1348	1325	1253	1134
New Hampshire	310	318	295	297	301	306	295	259
New York	240	238	239	206	211	210	193	172
North Carolina	1183	1210	1067	910	906	869	820	692
Rhode Island	207	291	279	248	241	233	224	214
South Carolina	888	963	915	812	705	770	727	614
Tennessee	105	109	99	83	80	74	67	64
Virginia	97	111	112	98	86	89	81	74
All Other	435	459	447	394	374	380	365	300

STOCKS OF LINTERS, HELD AT MILLS, AND IN PUBLIC STORAGE OR AT COMPRESSES AT THE CLOSE OF THE SEASON: 1913–1918.

(In running bales, counting round as half bales. United States Census Data.)

Season Ending	Stocks in Mills			In Public Storage or at Compresses
	Total	In Cotton-growing States	In All Other States	
1918	138,342	63,275	75,067	236,118
1917	112,072	14,574	98,398*	230,687
1916	100,441	33,463	66,978	113,106
1915	198,905	96,530	102,375	89,881
1914	75,346	13,064	62,282	32,366
1913	60,454	10,525	49,929	29,148

* Includes Mississippi.

COTTON AND LINTERS CONSUMED IN THE UNITED STATES: 1906–1918.

Running bales except foreign cotton which is in equivalent 500-pound bales.

(United States Census Data.)

Month and Season Ending		Cotton and Linters Consumed (Bales)						
		United States	Domestic	Foreign	Linters	Cotton-growing States	New England States	All Other States
August	31	648,384	547,865	21,623	78,896	372,517	222,730	53,137
September	30	611,560	504,472	17,917	89,171	350,755	209,047	50,858
October	31	694,721	575,561	19,005	100,155	392,503	243,230	58,988
November	30	671,375	571,355	19,072	80,948	385,818	232,161	53,396
December	31	591,947	501,125	15,373	75,449	341,760	200,483	49,704
January	31	593,764	509,206	14,741	69,817	355,879	192,471	45,414
February	28	598,045	496,494	13,590	87,961	358,051	193,450	46,544
March	31	680,710	556,952	14,491	109,207	383,968	241,871	54,871
April	30	650,236	532,294	11,830	106,112	373,797	224,398	52,041
May	31	688,175	564,941	13,340	109,894	390,055	242,977	55,143
June	30	629,818	516,003	11,461	102,354	361,310	215,889	52,619
July	31	648,153	530,334	11,458	106,361	370,494	222,916	54,743
1918		7,706,888	6,406,602	183,901	1,116,385	4,436,907	2,642,523	627,458
1917		7,658,207	6,470,244	318,261	869,702	4,335,007	2,654,138	669,062
1916		7,278,529	6,080,618	316,995	880,916	3,977,130	2,627,150	674,249
1915		6,009,207	5,375,305	222,057	411,845	3,193,353	2,197,220	618,634
1914		5,884,733	5,383,099	194,309	307,325	3,023,415	2,251,041	610,277
1913		5,786,330	5,250,392	232,029	303,009	2,960,518	2,210,813	614,999
1912		5,367,583	4,921,683	207,663	238,237	2,712,223	2,108,360	547,000
1911		4,704,978	4,322,987	175,430	206,561	2,328,487	1,911,092	465,399
1910		4,798,953	4,465,968	155,774	177,211	2,292,333	2,016,386	490,234
1909		5,240,719	4,929,796	161,738	149,185	2,553,797	2,144,448	542,474
1908		4,539,090	4,389,642	149,628	(*)	2,187,096	1,894,835	457,159
1907		4,984,936	4,844,568	140,368	(*)	2,410,993	2,073,355	500,588
1906		4,909,279	4,770,804	138,475	(*)	2,373,577	2,059,900	475,802

* Linters consumed included under "Domestic." Separate statistics not available.

SUPPLY AND DISTRIBUTION OF COTTON AND LINTERS IN THE UNITED STATES: 1913-1917.

(Quantities are given in running bales, except that round bales are counted as half bales and foreign cotton is in equivalent 500-pound bales. United States Census Data.)

	1917	1916	1915	1914	1913
SUPPLY:					
Stock on hand at beginning of season:					
Northern consuming establishments	1,014,569	926,359	642,316	543,649	629,035
Southern consuming establishments	718,117	673,731	347,664	234,509	241,611
Total in consuming establishments	1,732,686	1,600,090	989,980	778,158	870,646
In public storage and at compresses	1,220,570	1,874,800	457,468	495,280	556,239
Elsewhere (estimated)	450,000	850,000	100,000	375,000	350,000
Total stocks at beginning of season	3,403,256	4,324,890	1,547,448	1,648,438	1,776,885
Net imports	288,486	420,995	363,595	265,646	225,460
Ginnings	12,664,078	12,012,813	16,738,241	14,290,320	14,159,078
To balance distribution	250,228	214,197	264,376	288.004	114,311
Total supply	16,606,048	16,972,895	18,913,660	16,492,408	16,275,734
DISTRIBUTION:					
Consumed:					
In northern establishments	3,323,200	3,301,399	2,815,854	2,861,318	2,825,812
In southern establishments	4,335,007	3,977,130	3,193,353	3,023,415	2,960,518
Total mill consumption	7,658,207	7,278,529	6,009,207	5,884,733	5,786,330
Exported	5,739,009	6,191,110	8,544,563	8,914,839	8,800,966
Burned	35,000	100,000	35,000	45,000	40,000
Total distribution	13,432,216	13,569,639	14,588,770	14,844,572	14,627,296
Stocks on hand at end of season:					
In northern consuming establishments	892,826	1,014,569	926,359	537,801	543,649
In southern consuming establishments	609,090	718,117	673,731	213,418	234,509
Total in consuming establishments	1,614,888*	1,732,686	1,600,090	751,219	778,158
In public storage and at compresses	1,118,944	1,220,570	1,874,800	576,617	495,280
Elsewhere (estimated)	440,000	450,000	850,000	320,000	375,000
Total stocks at end of season	3,173,832	3,403,256	4,324,890	1,647,836	1,648,438
Total Distribution	16,606,048	16,972,895	18,913,660	16,492,408	16,275,734

* Includes 112,072 bales of linters held in consuming establishments but not allocated by the Census.

QUANTITIES AND VALUES OF ANNUAL EXPORTS OF COTTON CLOTH OF U. S. MANUFACTURE.

(Compiled from United States Commerce Report.)

	Twelve Months Ending June 30					
	1918		1917		1914	
	Yards	*Value*	*Yards*	*Value*	*Yards*	*Value*
Manufactures of Cloth—						
Duck						
Unbleached	6,364,680	$3,564,660	14,274,019	$5,747,100	–	–
Bleached	2,362,460	1,155,768	1,892,106	618,252	–	–
Colored	1,146,562	371,777	1,528,486	442,189	–	–
Other Cloths—						
Unbleached	92,528,613	11,558,620	142,821,009	10,585,422	199,886,679	$13,838,005
Bleached	142,060,195	20,401,024	99,674,268	9,992,773	42,104,861	3,392,969
Colored	–	–	–	–	172,868,473	11,613,653
Printed	173,517,802	21,164,835	148,408,387	12,378,566	–	–
Dyed in the piece	141,717,994	24,737,091	58,783,943	7,097,945	–	–
All other	125,282,367	20,527,444	222,711,342	25,743,049	–	–
Total Cloths	684,980,673	$103,481,219	690,093,560	$72,605,296	414,860,013	$28,844,627
Exported to—						
United Kingdom	564,842	$190,417	5,579,412	$2,207,003	2,386,618	$395,938
Canada	58,768,964	11,573,287	76,342,865	10,077,098	20,979,629	1,973,147
Central American States and British Honduras	39,240,418	4,983,315	68,601,722	5,428,335	36,615,841	2,217,031
Mexico	107,907,164	14,497,812	74,398,834	7,871,244	4,052,598	405,277
Cuba	81,081,488	10,759,378	58,194,600	5,737,149	23,598,568	1,590,116
Haiti	10,910,917	1,685,381	24,796,499	2,332,675	22,850,806	1,793,384
Other West Indies and Bermuda	43,835,313	5,643,988	43,630,582	4,124,637	28,329,993	1,738,288
Argentina	51,685,737	10,047,263	37,104,274	4,225,513	–	–
Brazil	113,125	72,627	5,467,569	800,325	567,036	72,405
Chile	10,918,933	1,451,912	27,272,404	2,687,222	10,253,969	722,745
Colombia	11,255,490	1,376,288	32,283,630	2,628,601	14,571,176	757,058
Other South America	7,295,808	1,267,587	63,975,667	6,363,448	16,223,842	1,242,240
Aden	1,710,000	173,088	16,962,000	1,132,067	17,739,572	1,018,876
China	4,200,639	565,223	3,831,404	358,911	89,156,450	6,096,408
British East Indies	116,887	35,532	7,028,532	721,643	14,890,899	1,063,798
Hongkong	250,478	75,674	734,670	110,270	818,900	124,370
Australia *	11,578,484	2,335,289	14,477,530	1,898,923	8,128,409	828,648
Philippine Islands	119,506,853	15,601,314	86,560,139	7,888,497	86,140,532	5,536,157
Other Asia and Oceania	81,374	59,202	8,985,520	1,287,952	3,333,345	302,027
Other countries	124,257,759	21,086,642	33,865,617	4,723,783	14,212,830	966,714

*Including New Zealand and British Oceania.

Figures for 1918 are preliminary and subject to change. In some cases the 1918 figures refer to principal items only, the balance being included under "Other Countries."

COTTON GINNED TO SPECIFIED DATES AND THROUGHOUT THE SEASON: 1913–1917.

(Quantities are given in running bales, except that round bales are counted as half bales. Linters are not included. United States Census Data.)

Cotton Ginned to	Year of Growth					Five Year Average
	1917	1916	1915	1914	1913	
September 1	614,787	850,668	463,883	480,317	709,099	639,896
September 25	2,511,658	4,081,989	2,903,829	3,393,752	3,246,655	3,224,921
October 18	5,573,606	7,303,183	5,708,730	7,619,747	6,973,518	6,635,360
November 1	7,185,178	8,623,893	7,378,886	9,826,912	8,830,396	8,362,068
November 14	8,571,115	9,615,003	8,771,275	11,668,240	10,444,529	9,811,687
December 1	9,713,529	10,352,031	9,703,612	13,073,386	12,088,412	10,984,412
December 13	10,131,594	10,838,799	10,306,309	13,972,229	12,927,428	11,637,525
January 1	10,434,852	11,039,401	10,636,778	14,443,146	13,347,721	11,983,507
January 16	10,570,733	11,137,712	10,751,090	14,915,850	13,582,036	12,101,413
Total	11,248,242	11,363,915	11,068,173	15,905,840	13,982,811	12,710,400

PER CENT. OF THE TOTAL COTTON GINNED TO SPECIFIED DATES: 1913–1917.

(Based on previous table.)

Per Cent. Ginned to	Year of Growth					Average Per Cent.
	1917	1916	1915	1914	1913	
September 1	5.5	7.5	4.2	3.0	5.7	5.2
September 25	22.3	35.9	26.2	21.3	23.2	25.7
October 18	49.6	64.3	51.6	47.9	49.9	52.7
November 1	63.9	75.9	66.7	61.8	63.2	66.2
November 14	76.2	84.6	79.2	73.4	74.7	77.6
December 1	86.4	91.1	87.7	82.2	86.5	86.8
December 13	90.1	95.4	93.1	87.8	92.5	91.8
January 1	92.8	97.1	96.1	90.8	95.5	94.5
January 16	94.0	98.0	97.1	93.8	97.1	96.0

COTTON STOCKS, EXCLUSIVE OF LINTERS, HELD AT MILLS, AND ELSEWHERE, MONTHLY 1917–1918, AND AT THE CLOSE OF THE SEASON: 1913–1918.

(Running bales, counting round as half bales. United States Census Data.)

Month and Season Ending	Stocks in Mills					In Public Warehouses or at Compresses
	Total	Domestic	Foreign	In Cotton-growing States	In All Other States	
August 31	1,178,803	1,092,194	86,609	389,848	788,955	744,069
September 30	959,324	877,928	81,396	298,217	661,107	1,570,951
October 31	1,085,770	1,012,909	72,861	538,480	547,290	3,030,455
November 30	1,408,327	1,348,366	59,961	866,775	541,552	3,745,485
December 31	1,576,514	1,525,028	51,486	995,075	581,439	3,826,225
January 31	1,697,445	1,653,906	43,539	1,104,297	593,148	3,616,078
February 28	1,694,455	1,650,927	43,528	1,063,384	631,071	3,423,391
March 31	1,721,311	1,683,807	37,504	1,065,269	656,042	3,258,499
April 30	1,807,055	1,761,427	45,628	1,017,242	789,813	2,843,553
May 31	1,795,497	1,743,991	51,506	887,850	907,647	2,414,831
June 30	1,661,992	1,604,376	57,616	731,887	930,105	2,117,300
July 31	1,465,384	1,402,670	62,714	577,721	887,663	1,764,873
1918	1,465,384	1,402,670	62,714	577,721	887,663	1,764,873
1917	1,501,916	1,407,605	94,311	609,090	892,826	888,257
1916	1,632,245	1,489,727	142,518	684,654	947,591	1,107,464
1915	1,401,185	611,724	108,782	577,201	823,984	1,784,919
1914	675,873	637,724	64,149	195,490	480,383	425,102
1913	717,704	637,725	79,979	219,184	498,520	381,739

CHAIN DRIVES

By J. S. White

A consideration of the subject of Chain Driving is just now timely in view of the greatly increased use of Silent Chains during the past few years for general power transmission purposes. Some study of this should now be particularly interesting to the Cotton Mill Engineer, because this method of transmitting power has not been adopted in Cotton Mills to the same extent that it has in other classes of mills using relatively the same amount of power. Just why this should be, it is difficult to say, as anything that tends to insure continuity of service—and to increase the production from machines—is as desirable in a Cotton Mill as any other. These are two of the important reasons that have led to the installation of many Chain Drives during the past four years. Large installations of Silent Chains have been made to run machines working on important government contracts where any interruption in the service not only would mean a loss in dollars and cents, but would cause delays, which must of all things be avoided.

The record of the Chain Drives used has been an enviable one. They have been running twenty to twenty-four hours a day (many since the first year of the war) in textile mills, steel mills, paper mills, rubber mills, machine shops, etc., and are still giving good service. The records of these Chain Drives show an extremely low maintenance cost, nothing more than required in the way of lubrication and adjustment in the majority of cases. Furthermore, the reports from these installations indicate a very definite increase in production from the machines, attributable to the Chain Drive; on account of the positive speed ratio and the fact that the machine can be driven constantly at its most desirable speed, irrespective of surrounding conditions due to load variation, weather, and the presence of more or less fly or dust in the air.

Chain Drives are now recognized by competent engineers throughout the United States as a legitimate means of power transmission within their field. A properly designed and constructed Chain Drive will show an efficiency of over $98\frac{1}{2}\%$; and, unlike other forms of mechanical power transmitters, this high efficiency is practically sustained throughout their life. The Chain Drive is compact, provides a positive speed ratio, and still possesses inherent in itself considerable elasticity. Silent Chains are manufactured in nine different pitches, each

in a number of widths; so that successful designs are possible for light loads at high speeds, by using the short pitch chains, or for heavy loads at slower speeds, for which the long pitch chains are adapted. Individual Chain Drives, transmitting as much as 5000 H.P., are in successful operation in this country today. The Chain Drive is in effect a flexible gear set, the chain forming a flexible rack which is connected around and engages two gears called sprockets. In the Silent Chain of today,

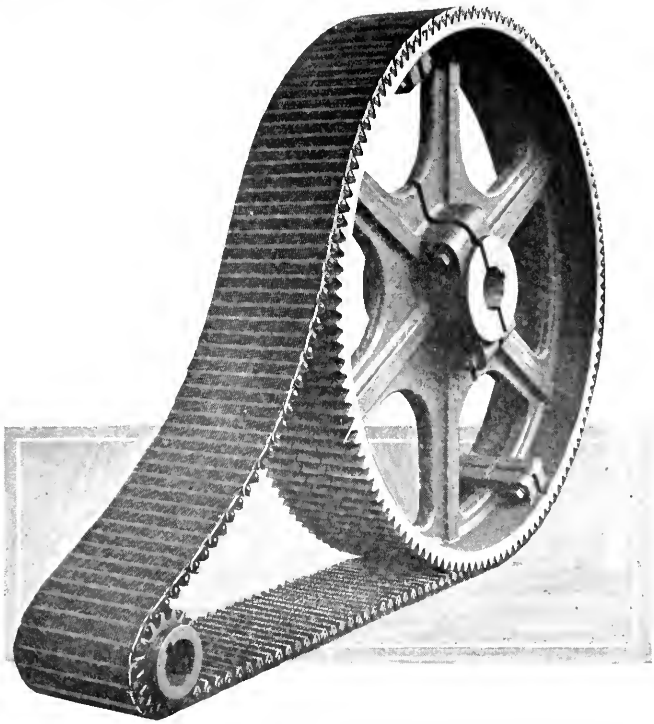

Fig. 1. GENERAL CONSTRUCTION OF CHAIN DRIVE

the links are formed so that they will be compensating on the sprockets —that is, when the chains are allowed to run somewhat slack, they ride out to their true pitch circle on the sprockets engaging the teeth all around so far as they wrap and practically distribute the load evenly among all the sprocket teeth in engagement. There are several makes of Silent Chain now on the market, differing mainly in their joint construction. They are all made up of steel link plates assembled on edge on the joint pins and held in this position. Figure 1 will illustrate the general construction of a typical Chain Drive of the Rocker-Joint type.

For service in Cotton Mills the Chain Drive will be found advantageous in many cases for driving from motors to shafting or heavy machines such as pumps, compressors, etc. They have been used with particularly good results as a transmission from water-wheel shafts to main lines or generators, and as a connection between two water-wheel shafts, each direct connected to a line where it was desired to equalize the load. They form an ideal transmission to connect motors to the lighter textile machines. No special knowledge is required to successfully install and operate a Chain Drive. It is necessary only to install them in a workmanlike manner with the sprockets in line and the shafts parallel and held securely in place. Chain Drives do not have to be lubricated with a light oil but preferably with a clear vaseline grease. It is not necessary or even desirable, therefore, to run chains in an oil bath. It is desirable, however, to encase Chain Drives under some conditions; and particularly in Cotton Mills there is generally a fly in the air that tends to dry out the lubricant quickly, and chains cannot be properly lubricated unless protected to some extent from this. This case, however, forms an effectual guard over the drive and is further desirable from this standpoint as a protection against accident.

There is one application of Chain Drives in Cotton Mill service that has been worked out successfully within the past five years, and that deserves special mention. That is their use on spinning frames and twisters. The Chain Drive has provided here a successful transmission from individual motors to the cylinder shaft and has overcome one serious objection to the individual motor equipment for these machines. A special chain had to be developed for this service that would stand the high speed and load conditions. Many mills have within the past three or four years equipped their spinning frames and twisters with individual motors and Chain Drive, but at present we must look to Southern territory to see the largest installations. There is no longer any doubt about the desirability of Chain Drives for this service, principally because of the increased production from the frames that has been noted in the case of every installation. The percentage of increase in production varies, depending on the basis of comparison, but no system of belt drive (group drive with straight and crossed belts or bicycle drive or four frame drive) for spinning frames and twisters can compare with Chain Drive in the results obtained. The Chain Drive, owing to its flexibility and freedom from vibration, will show an increase in production over gear drive from individual motors. The individual motors with Chain Drive are preferable to direct connected

motors, as with the Chain Drive standard motors running 1800 R.P.M. can be used, and the speed of cylinder shaft can be easily varied as occasion may demand by changing the speed ratio of the chain sprockets.

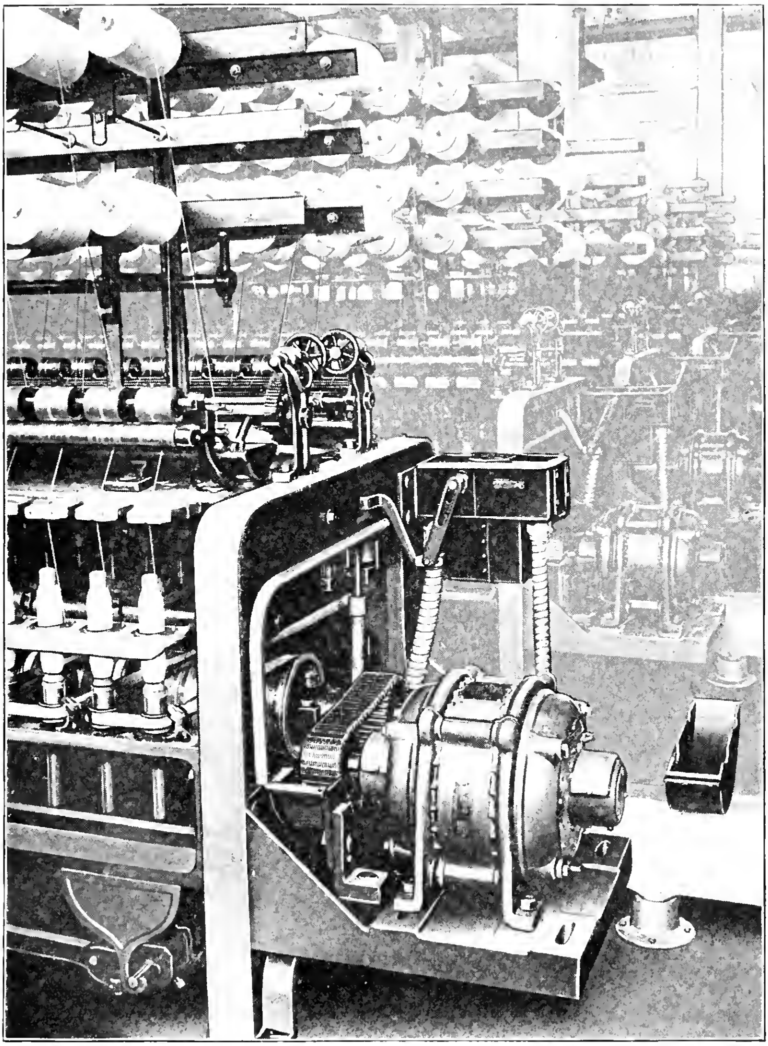

FIG. 2. MOUNTING OF MOTOR AND CHAIN DRIVE IN TEXTILE MILL

The design for Chain Drives for cotton spinning frames is special and varies from the usual practice in designing Chain Drives for general service. The chains are run much faster on very short centers,

and the safe working tensions per inch in width are correspondingly reduced. It has generally been the custom to mount the individual motor and Chain Drive on the foot end of the frame as shown in Figure 2. It will be noted that the motor is set so that the armature shaft is at about the same level as the cylinder shaft and a center distance of from 8″ to 10″ is provided. Most manufacturers of spinning frames now

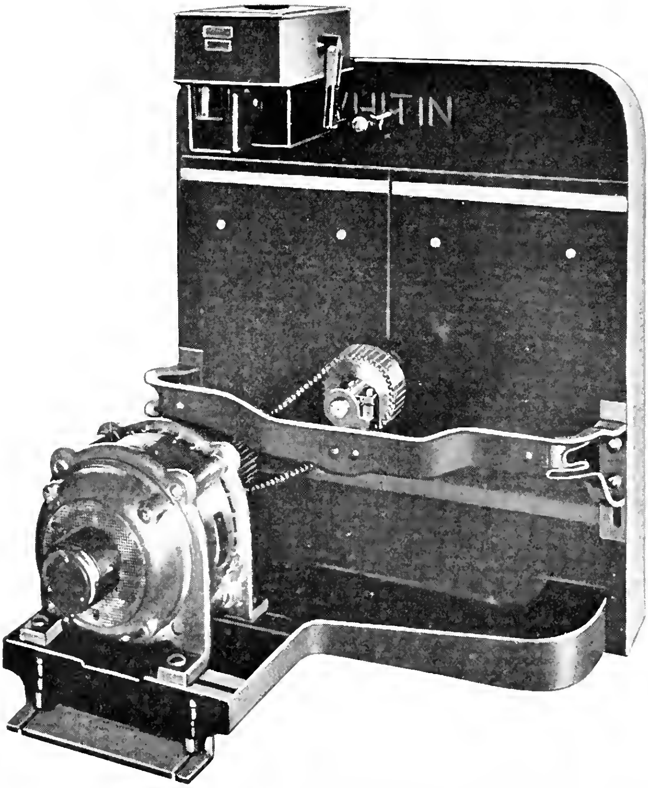

Fig. 3. MOUNTING OF MOTOR AND CHAIN DRIVE ON HEAD END OF SPINNING FRAME

supply a standard bracket for their frames to carry these motors and with necessary supports for the chain cases. This also carries an outboard bearing for the cylinder shaft. These supports must be substantial, as the shafts must be held securely in place, and not spring under any load condition that is encountered.

The motor and drive can be mounted on the head end of the spinning frame as shown in Figure 3. This applies the power to the cylinder shaft at a point nearer where it is taken off, but it is necessary to

Fig. 4. DATA TO BE USED IN THE DESIGN OF SILENT CHAIN DRIVES

Note 1.—Number of teeth = T.
Exact outside diameter = D.
For T less than 32 teeth, D = pitch diameter.
For T more than 32 teeth, D = pitch diameter + (2 × addendum).

Note 2.—Use sprockets having an odd number of teeth whenever possible.

Note 3.—When specially authorized, a larger number of teeth than shown may be cut in large sprocket.

Note 4.—Thickness of sprocket rim, including teeth, should be at least 1.2 times the chain pitch.

Note 5.—The number of grooves in the sprocket, their width and distance apart, varies according to pitch and width of chain. In every case leave the designing and turning of these grooves to the manufacturer.

Note 6.—The width of the sprocket should be $\frac{1}{8}$ to $\frac{1}{4}$ inch greater on small drives, and $\frac{1}{4}$ to $\frac{1}{2}$ inch greater on large drives than normal width of the chain.

Note 7.—An even number of links in the chain and an odd number of teeth in the wheels are desirable.

Note 8.—Horizontal drives preferred. In general, slack chain should be on top but for short drives running at high speed it is desirable to run chains with slack on bottom.

Note 9.—Adjustable wheel centers desirable for horizontal drives and necessary for vertical drives.

Note 10.—Avoid vertical drives.

Note 11.—Allow a side clearance for chain (parallel to axis of sprockets and measured from nominal width of chain) equal to the pitch.

Note 12.—Desirable linear velocity for commercial service 1000 to 1500 feet per minute.

These data are for use in preliminary design. Engineering features should always be submitted to the manufacturer for approval before ordering.

Pitch, inches	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{9}{16}$	$1\frac{2}{16}$	$1\frac{1}{2}$	2	3
Minimum number of teeth: Small sprocket driver	13	13	13	15	15	17	17	17
Small sprocket driven	17	17	21	25	29	29	31	35
Desirable number of teeth in small sprockets	15–17	17–21	17–21	17–23	17–23	17–27	17–31	19–31
Maximum number of teeth in large sprockets. (See Note 3.)	99	109	115	125	129	129	129	131
Desirable number of teeth in large sprockets	55–75	55–75	55–85	55–95	55–105	55–115	55–115	55–115
To find pitch diameter of wheel multiply number of teeth by	0.159	0.199	0.239	0.2865	0.382	0.477	0.636	0.955
Addendum for outside diameter of sprockets 20 to 130 T. (See Note 1.) inches	0.10	0.12	0.15	0.18	0.24	0.30	0.40	0.60
Maximum R.P.M.	2,400	1,800	1,200	1,100	800	600	400	250
Tension per inch width chain, pounds: Small sprocket driver	80	100	120	150	200	270	450	750
Small sprocket driven	65	80	95	120	160	210	350	600
Radial clearance beyond tooth required for chain, inches	0.50	0.62	0.75	0.90	1.2	1.5	2.0	3.0
Approximate weight of chain per inch wide, 1 foot long, pounds	1.00	1.20	1.50	1.80	2.50	3.00	4.00	6.00
C for solid pinions	0.0045	0.0063	0.009	0.013	0.023	0.035	0.058	0.145
C for armed sprockets	0.16	0.25	0.35	0.45	0.7	1.0	2.0	4.0

Approximate Weights for Solid and Armed Sprockets

T = Number of teeth. F = Face in inches. C = Constant in pounds per inch in face per tooth as per table.
Weight of armed sprocket = $T \times F \times C$.
Add 25% for split and 50% for spring and split sprockets.
Weight of solid pinion = $T^2 \times (F + 1) \times C$.

mount the motor lower in order to provide access to the head end of the frame. This makes the motor bracket and supports somewhat more complicated.

Figure 5 is put in here principally to show the "staggered" setting of the motors on these frames. This arrangement of the motors made it possible to apply this equipment to the old frames in this spinning room without moving them. This cut also gives some idea of the improved sanitary conditions and the increased amount of light and air in a spinning room with all the overhead shafting and belts removed.

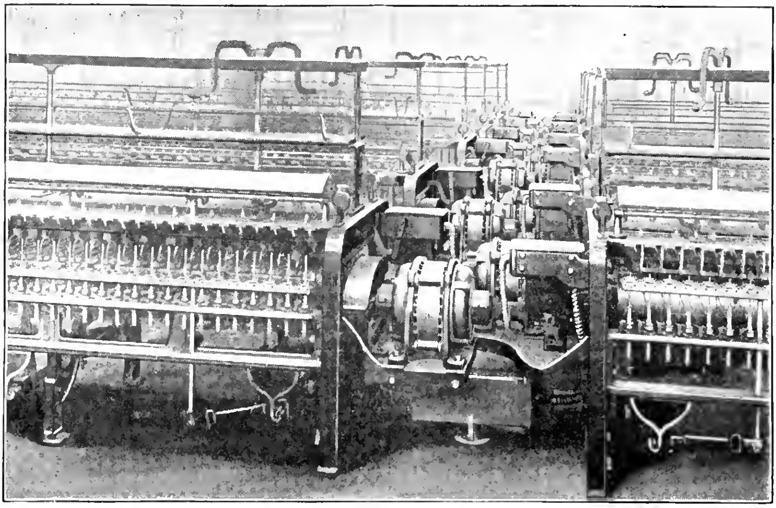

Fig. 5. SHOWING STAGGERED SETTING OF MOTORS ON SPINNING FRAMES

In conclusion, a word about the general design of Chain Drives may be pertinent. Figure 4 gives a table of engineering data that shows substantially what is good practice at the present time. The safe working loads per inch in width for the chains should be taken for Drives that will operate under favorable conditions. Where the service is severe, these tensions should be reduced from 10% to 30%.

The best results for any mill contemplating an installation of Chain Drives will be obtained by a close co-operation with the chain manufacturer. His organization includes a corps of trained engineers who have had a long experience in their special line of work. If they are furnished with full information in regard to the conditions of service, their recommendations and designs can be adopted with confidence.

NEW YORK COTTON EXCHANGE PRICES, PER POUND, FOR "SPOT" MIDDLINGS UPLAND.

HIGHEST AND LOWEST: 1893–1918.

Season Ending	High	Low	Season Ending	High	Low
	Cents	*Cents*		*Cents*	*Cents*
1918	36.00	21.20	1905	11.65	6.85
1917	27.65	13.35	1904	17.25	9.50
1916	13.45	9.20	1903	13.50	8.30
1915	10.60	7.25	1902	$9\frac{7}{8}$	$7\frac{13}{16}$
1914	14.50	11.00	1901	12	$8\frac{1}{16}$
1913	13.40	10.75	1900	$10\frac{1}{4}$	$6\frac{1}{4}$
1912	13.40	9.20	1899	$6\frac{5}{8}$	$5\frac{5}{16}$
1911	19.75	12.30	1898	$8\frac{1}{4}$	$5\frac{13}{16}$
1910	16.45	12.40	1897	$8\frac{7}{8}$	$7\frac{1}{16}$
1909	13.15	9.00	1896	$9\frac{3}{8}$	$7\frac{1}{16}$
1908	13.55	9.90	1895	$7\frac{3}{8}$	$5\frac{9}{16}$
1907	13.50	9.60	1894	$8\frac{9}{16}$	$6\frac{15}{16}$
1906	12.60	9.85	1893	10	$7\frac{1}{16}$

MONTHLY PRICES OF COTTON.

Average price, cents per pound, to producers of cotton, monthly, 1908–1918.
Estimates of United States Department of Agriculture.

	1918	1917	1916	1915	1914	1913	1912	1911	1910	1909	1908
January 1	28.9	17.1	11.4	6.6	11.7	12.2	8.4	14.4	14.6	8.4	10.7
February 1	29.7	16.8	11.5	7.4	11.9	11.9	9.0	14.3	14.0	9.0	10.8
March 1	30.2	15.9	11.1	7.4	12.6	11.8	9.8	13.9	14.0	9.0	11.0
April 1	31.8	18.0	11.5	8.1	11.9	11.8	10.1	13.9	14.1	9.1	10.2
May 1	28.5	18.9	11.5	9.1	12.2	11.6	10.9	14.2	14.0	9.6	9.6
June 1	27.4	20.2	12.2	8.6	12.4	11.5	11.0	14.6	14.2	10.1	10.6
July 1	28.6	24.7	12.5	8.6	12.4	11.6	11.2	14.4	13.9	10.3	10.9
August 1	27.8	24.3	12.6	8.1	12.4	11.5	12.0	13.2	14.3	11.3	10.3
September 1	–	23.4	14.6	8.5	8.7	11.8	11.3	11.8	14.4	11.7	9.4
October 1	–	23.3	15.5	11.2	7.8	13.3	11.2	10.2	13.3	12.6	9.0
November 1	–	27.3	18.0	11.6	6.3	13.0	10.9	8.9	14.0	13.7	8.7
December 1	–	27.7	19.6	11.3	6.8	12.3	11.9	8.8	14.1	13.9	8.7

AVERAGE WEEKLY PRICES OF 27 IN., 64 x 60, 7.60 YD. PRINTING CLOTHS.

(Quotations furnished by Messrs. J. M. Prendergast & Co., Boston.)

Week Ending*		1917	1916	1915	1914
August	4 . .	$7\frac{1}{8}$	4c	$2\frac{11}{16}$	$3\frac{3}{16}$
	11 . .	$7\frac{1}{8}$	4c	$2\frac{11}{16}$	$3\frac{1}{8}$
	18 . .	$7\frac{1}{8}$	4c	$2\frac{11}{16}$	$3\frac{1}{8}$
	25 . .	$7\frac{1}{8}$	$4\frac{1}{8}$	$2\frac{11}{16}$	$3\frac{1}{8}$
September	1 . .	$6\frac{7}{8}$	$4\frac{3}{8}$	$2\frac{3}{4}$	$2\frac{7}{8}$
	8 . .	$6\frac{7}{8}$	$4\frac{1}{2}$	$2\frac{13}{16}$	$2\frac{7}{8}$
	15 . .	$6\frac{3}{4}$	$4\frac{1}{2}$	$2\frac{7}{8}$	$2\frac{7}{8}$
	22 . .	$6\frac{7}{8}$	$4\frac{1}{2}$	3	$2\frac{7}{8}$
	29 . .	7	$4\frac{1}{2}$	$3\frac{1}{4}$	$2\frac{5}{8}$
October	6 . .	$7\frac{1}{8}$	$4\frac{3}{4}$	$3\frac{1}{4}$	$2\frac{1}{2}$
	13 . .	$7\frac{3}{8}$	$4\frac{7}{8}$	$3\frac{1}{4}$	$2\frac{1}{2}$
	20 . .	$7\frac{1}{2}$	$5\frac{1}{8}$	$3\frac{1}{4}$	$2\frac{1}{2}$
	27 . .	$7\frac{3}{4}$	$5\frac{1}{4}$	$3\frac{1}{4}$	$2\frac{1}{2}$
November	3 . .	$7\frac{7}{8}$	$5\frac{1}{2}$	$3\frac{1}{8}$	$2\frac{5}{8}$
	10 . .	$7\frac{7}{8}$	$5\frac{1}{2}$	$3\frac{1}{8}$	$2\frac{1}{2}$
	17 . .	8	$5\frac{1}{2}$	$3\frac{1}{8}$	$2\frac{1}{2}$
	24 . .	$8\frac{1}{4}$	$5\frac{1}{2}$	$3\frac{1}{8}$	$2\frac{1}{2}$
December	1 . .	$8\frac{1}{2}$	$5\frac{5}{8}$	$3\frac{1}{8}$	$2\frac{7}{16}$
	8 . .	$8\frac{1}{2}$	$5\frac{5}{8}$	$3\frac{1}{8}$	$2\frac{7}{16}$
	15 . .	$8\frac{1}{2}$	$5\frac{3}{8}$	$3\frac{1}{4}$	$2\frac{7}{16}$
	22 . .	$8\frac{1}{2}$	$5\frac{1}{4}$	$3\frac{1}{4}$	$2\frac{7}{16}$
	29 . .	$8\frac{1}{2}$	$5\frac{1}{4}$	$3\frac{1}{4}$	$2\frac{7}{16}$
		1918	1917	1916	1915
January	5 . .	$8\frac{1}{2}$	$5\frac{3}{8}$	$3\frac{3}{8}$	$2\frac{7}{16}$
	12 . .	$8\frac{3}{4}$	$5\frac{1}{2}$	$3\frac{3}{8}$	$2\frac{1}{2}$
	19 . .	9	$5\frac{3}{8}$	$3\frac{1}{2}$	$2\frac{5}{8}$
	26 . .	$9\frac{1}{4}$	$5\frac{3}{8}$	$3\frac{1}{2}$	$2\frac{11}{16}$

Week Ending*		1918	1917	1916	1915
February	2 . .	10	$5\frac{1}{4}$	$3\frac{1}{2}$	$2\frac{11}{16}$
	9 . .	$10\frac{1}{4}$	5	$3\frac{7}{16}$	$2\frac{5}{8}$
	16 . .	$10\frac{1}{4}$	5	$3\frac{7}{16}$	$2\frac{5}{8}$
	23 . .	$10\frac{3}{4}$	$5\frac{1}{8}$	$3\frac{1}{2}$	$2\frac{9}{16}$
March	2 . .	11	$4\frac{3}{4}$	$3\frac{7}{16}$	$2\frac{5}{8}$
	9 . .	$11\frac{3}{4}$	5	$3\frac{1}{2}$	$2\frac{5}{8}$
	16 . .	12	5	$3\frac{5}{8}$	$2\frac{5}{8}$
	23 . .	$12\frac{1}{4}$	$5\frac{1}{4}$	$3\frac{5}{8}$	$2\frac{11}{16}$
	30 . .	$12\frac{1}{2}$	$5\frac{1}{2}$	$3\frac{5}{8}$	$2\frac{11}{16}$
April	6 . .	$12\frac{3}{4}$	$5\frac{1}{2}$	$3\frac{3}{4}$	$2\frac{3}{4}$
	13 . .	$13\frac{1}{4}$	$5\frac{5}{8}$	$3\frac{3}{4}$	$2\frac{7}{8}$
	20 . .	$13\frac{1}{4}$	$5\frac{3}{4}$	$3\frac{7}{8}$	3
	27 . .	13	$5\frac{3}{4}$	$3\frac{7}{8}$	$3\frac{1}{16}$
May	4 . .	$12\frac{3}{4}$	$5\frac{7}{8}$	$3\frac{7}{8}$	3
	11 . .	$12\frac{3}{4}$	$5\frac{7}{8}$	$3\frac{15}{16}$	3
	18 . .	$12\frac{3}{4}$	$6\frac{1}{8}$	$3\frac{15}{16}$	3
	25 . .	13	$6\frac{1}{4}$	$3\frac{15}{16}$	$2\frac{15}{16}$
June	1 . .	13	$6\frac{1}{2}$	$3\frac{15}{16}$	$2\frac{31}{32}$
	8 . .	13	$6\frac{3}{4}$	$3\frac{7}{8}$	$2\frac{15}{16}$
	15 . .	13	7	$3\frac{7}{8}$	$2\frac{7}{8}$
	22 . .	13	$7\frac{1}{8}$	$3\frac{3}{4}$	$2\frac{7}{8}$
	29 . .	$11\frac{1}{4}$	$7\frac{1}{4}$	$3\frac{13}{16}$	$2\frac{7}{8}$
July	6 . .	$11\frac{1}{4}$	$7\frac{1}{4}$	$3\frac{7}{8}$	$2\frac{7}{8}$
	13 . .	$11\frac{1}{4}$	$7\frac{1}{4}$	$3\frac{7}{8}$	$2\frac{13}{16}$
	20 . .	$11\frac{1}{4}$	$7\frac{1}{4}$	$3\frac{7}{8}$	$2\frac{13}{16}$
	27 . .	$11\frac{1}{4}$	$7\frac{1}{4}$	$3\frac{7}{8}$	$2\frac{3}{4}$

* Dates refer to 1917–1918 season, other years are for corresponding weeks

WEEKLY SALES OF PRINT CLOTHS AT FALL RIVER.

(In thousands of Pieces)

(Data supplied by Messrs. J. M. Prendergast & Co., Boston.)

Date *		1917	1916	1915	1914	1913
August	4 .	120	250	150	30	113
	11 .	200	400	110	50	119
	18 .	100	300	100	75	238
	25 .	100	300	115	70	243
September	1 .	80	220	300	60	225
	8 .	60	120	175	50	261
	15 .	80	150	200	120	240
	22 .	120	220	225	150	240
	29 .	270	280	150	110	150
October	6 .	260	280	140	70	150
	13 .	220	175	150	80	62
	20 .	180	250	110	110	120
	27 .	210	260	130	280	110
November	3 .	230	140	100	260	75
	10 .	220	125	100	130	75
	17 .	290	165	130	140	75
	24 .	300	180	160	90	70
December	1 .	200	120	210	80	175
	8 .	200	125	220	100	95
	15 .	160	90	141	200	57
	22 .	140	70	200	131	71
	29 .	130	50	200	90	142
		1918	1917	1916	1915	1914
January	5 .	100	50	160	175	203
	12 .	200	55	215	260	192
	19 .	150	65	175	350	100
	26 .	100	120	150	140	130

Date		1918	1917	1916	1915	1914
February	2 .	140	70	150	110	92
	9 .	100	80	150	90	146
	16 .	100	170	250	60	100
	23 .	80	225	200	60	110
March	2 .	150	180	200	70	150
	9 .	170	300	250	100	90
	16 .	175	350	300	140	140
	23 .	180	380	300	360	270
	30 .	150	400	180	275	180
April	6 .	200	278	160	160	90
	13 .	200	350	150	300	60
	20 .	100	160	160	250	60
	27 .	50	150	160	100	70
May	4 .	80	160	200	135	110
	11 .	75	140	150	75	100
	18 .	230	180	90	50	280
	25 .	140	230	120	125	250
June	1 .	120	190	60	90	220
	8 .	160	200	85	90	140
	15 .	240	230	70	80	75
	22 .	100	140	90	110	60
	29 .	80	130	175	130	70
July	6 .	50	100	100	100	146
	13 .	160	100	170	110	146
	20 .	100	100	120	140	60
	27 .	90	50	160	161	70

* Dates refer to 1917-1918 season, other years are for corresponding weeks.

ACREAGE, CONDITION, CROP AND PRICE OF RAW COTTON: 1896-1918.

(United States Census and United States Department of Agriculture Data.)

Season Ending	Acreage (Thousands of Acres)	Crop Condition					Crop (Thousands of Running Bales)	Average Net Weight of Bale (Pounds)	Average Price Per Pound, Upland Cotton (Cents)
		May	June	July	Aug.	Sept.			
1919 .	37,073[1]	82.3	85.8	73.6	55.7	54.4			
1918 .	33,841	69.5	70.3	70.3	67.8	60.4	11,248	—	27.1
1917 .	34,985	77.5	81.1	72.3	61.2	56.3	11,364	482	17.3
1916 .	31,412	80.0	80.3	75.3	69.2	60.8	11,068	484	11.2
1915 .	36,832	74.3	79.6	76.4	78.0	73.5	15,906	485	7.3
1914 .	37,089	79.1	81.8	79.6	68.2	64.1	13,983	484	12.5
1913 .	34,283	78.9	80.4	76.5	74.8	69.6	13,489	486	11.5
1912 .	36,045	87.8	88.2	89.1	73.2	71.1	15,553	483	9.6
1911 .	32,403	82.0	80.7	75.5	72.1	65.9	11,568	480	14.0
1910 .	32,044	81.1	74.6	71.9	63.7	58.5	10,073	475	14.3
1909 .	32,444	79.7	81.2	83.0	76.1	69.7	13,086	484	9.2
1908 .	31,311	70.5	72.0	75.0	72.7	67.7	11,058	480	11.5
1907 .	31,374	84.6	83.3	82.9	77.3	71.6	12,983	489	10.0
1906 .	26,117	77.2	77.0	74.9	72.1	71.2	10,495	482	10.9
1905 .	30,054	83.0	88.0	91.6	84.1	75.8	13,451	478	8.7
1904 .	28,017	74.1	77.1	79.7	81.2	65.1	9,820	480	12.2
1903 .	27,114	95.1	84.7	81.9	64.0	58.3	10,588	481	8.2
1902 .	27,220	81.5	81.1	77.2	71.4	61.4	9,583	489	8.1
1901 .	25,758	82.5	75.8	76.0	68.2	67.0	10,102	480	9.3
1900 .	24,275	85.7	87.8	84.0	68.5	62.4	9,393	476	7.6
1899 .	24,967	89.0	91.2	91.2	79.8	75.4	11,189	489	4.9
1898 .	24,320	83.5	86.0	86.9	78.3	70.0	10,898	482	5.6
1897 .	23,273	97.2	92.5	80.1	64.2	60.7	8,533	477	7.3
1896 .	20,185	81.0	82.3	77.9	70.8	65.1	7,161	477	8.2

[1] Preliminary estimate of the Department of Agriculture, refers to acreage planted, figures for other years are for acreage harvested.

TABLE SHOWING CROP CONDITION REPORT OF THE UNITED STATES DEPARTMENT OF AGRICULTURE, THE INDICATED YIELD PER ACRE, THE ACTUAL YIELD PER ACRE, AND THE PERCENTAGE ERROR IN CONDITION REPORT: 1910–1917.

Year of Planting	Crop Condition					Indicated Yield					Actual Yield	Percentage Error of Indicated Yield				
	May	June	July	Aug.	Sept.	May	June	July	Aug.	Sept.		May	June	July	Aug.	Sept.
1918	82.3	85.8	73.6	55.7	54.4	189	197	177	142	151						
1917	69.5	70.3	70.3	67.8	60.4	163	159	168	175	169	**156**	+ 4.5	+ 1.9	+ 7.7	+12.2	+ 8.3
1916	77.5	81.1	72.3	61.2	56.3	186	190	175	162	159	**157**	+18.5	+21.0	+11.5	+ 3.2	+ 1.3
1915	80.0	80.3	75.3	69.2	60.8	182	188	182	181	170	**170**	+ 6.6	+10.6	+ 7.1	+ 6.5	0
1914	74.3	70.6	76.4	78.0	73.5	164	180	178	203	205	**209**	−28.0	−13.9	−14.8	− 2.9	− 1.9
1913	79.1	81.8	79.6	68.2	64.1	178	186	183	174	173	**182**	− 2.2	+ 2.2	+ .6	− 4.4	− 5.0
1912	78.9	80.4	76.5	74.8	69.6	180	186	176	191	191	**191**	− 6.1	− 2.6	− 7.9	0	0
1911	87.8	82.2	89.1	73.2	71.1	199	203	206	182	192	**208**	− 4.3	− 2.4	− 1.0	−12.5	− 7.7
1910	82.0	80.7	75.5	72.1	65.9	190	190	178	182	178	**171**	+11.1	+11.1	+ 4.1	+ 6.4	+ 4.1

Formula $Y/Y_5 = C/C_5$
where Y = the indicated yield
and C = crop condition

RELATIVE RATES OF WAGES PER HOUR FOR THE PRINCIPAL OCCUPATIONS IN THE COTTON MANUFACTURING INDUSTRY IN THE UNITED STATES: 1910–1916.

(United States Bureau of Labor Statistics Data.)
(1913=100.)

	Whole Industry	Card Strippers (Male)	Drawing-frame Tenders (Male)	Drawing-frame Tenders (Female)	Speeder Tenders (Male)	Speeder Tenders (Female)	Spinners, Mule (Male)	Spinners, Ring (Male)	Spinners, Ring (Female)	Slasher Tenders (Male)	Weavers (Male)	Weavers (Female)	Trimmers or Inspectors (Female)	Loom Fixers (Male)
1916	118	110	115	123	111	122	110	118	115	114	119	120	115	118
1914	102	104	106	103	103	101	102	105	104	100	104	101	101	102
1913	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1912	99	98	99	96	98	98	99	100	98	102	100	99	101	99
1911	91	88	99	84	93	89	90	86	89	92	93	90	93	89
1910	89	87	87	80	91	88	88	82	86	92	91	92	91	88
Per cent of average full time hours actually worked during period studied														
1916		91	82	90	84	91	94	80	85	97	82	87	91	94

NOTE.—Actual rates of wages, full time hours per week, and percentage of employees working specified hours, and earning specified rates per hour classified by occupations and states are available if desired.

WOVEN COTTON GOODS MANUFACTURED IN THE UNITED STATES IN 1904, 1909, 1914, CLASSIFIED BY STATES; AND BY PRODUCTS, 1914.

(Millions of Square Yards. United States Census Data.)

State	Total 1914	Total 1909	Total 1904	Product, 1914: Unbleach'd and Bleached Sheetings, Shirtings, and Muslins	Ducks	Ginghams	Napped Fabrics	Drills	Twills, Sateens, Etc.	All Other Fancy Weaves	Velvets, Corduroys, Plushes, Etc.	Towelling and Terry Weaves	Bags and Bagging	Tapestry	All Other Woven Goods
Total	6,814	6,340	5,110	3,852	251	490	204	290	392	717	29	76	129	10	312
Alabama	247	213	220	120	39	—	—	30	0	—	—	—	—	—	—
Connecticut	204	187	174	93	—	—	—	—	33	—	—	—	—	—	—
Georgia	506	489	378	313	78	—	16	60	15	39	—	15	24	—	—
Indiana	31	46	38	—	—	—	—	—	—	—	—	—	—	—	—
Maine	239	250	199	106	—	31	—	—	20	—	—	—	6	—	—
Maryland	18	21	23	—	13	—	—	—	—	—	—	—	—	—	—
Massachusetts	2,067	1,990	1,586	1,340	36	129	75	12	129	242	8	4	6	—	—
Mississippi	43	46	37		—	—	—	7	—	—	—	—	—	—	—
New Hampshire	358	405	348	55	—	—	50	—	45	—	—	6	3	—	—
New Jersey	41	40	30	—	10	—	—	—	5	—	—	1	—	—	—
New York	121	147	113	—	—	—	—	—	—	—	4	3	—	—	—
North Carolina	748	626	473	307	—	101	90	18	16	120	—	24	3	—	—
Pennsylvania	66	161	122			7	—		—	—	5	10	—	8	—
Rhode Island	351	363	300	205		—	—	—	74	—	5	—	—	—	—
South Carolina	1,344	1,079	872	1,062	—	26	—	99	14	99	—	—	10	—	—
Tennessee	70	63	38	—	—	—	—	—	—	—	—	—	—	—	—
Texas	42	37	21	—	28	—	—	—	—	—	—	—	—	—	—
Virginia	138	103	66	—	—	—	—	—	—	—	—	—	—	—	—
All other states	90	83	74	251	49	195	33	55	22	216	7	12	77	2	—

COTTON SPINDLES IN THE WORLD ACCORDING TO LATEST KNOWN ESTIMATES.

Country	Year	Spindles	Country	Year	Spindles
United States—North	1918	19,500,000	China	1917	1,126,568
United States—South	1918	14,834,357	Japan	1918	3,075,426
Great Britain	1918	59,000,000	Indo-China	1917	700,000
Canada	1918	1,050,000	Philippines	1916	7,440
Germany	1918	9,000,000	Brazil	1918	1,505,000
Russia	1918	8,000,000	Argentina	1914	9,000
France	1914	6,000,000	Chile	1916	5,000
Austria-Hungary	1918	4,000,000	Peru	1917	67,900
Switzerland	1917	1,454,494	Venezuela	1915	19,000
Italy	1918	4,500,000	Colombia	1914	20,000
Spain	1917	2,250,000	Ecuador	1911	5,000
Portugal	1917	428,000	Guatemala	1911	8,000
Belgium	1914	1,775,000	Mexico	1918	962,149
Holland	1918	500,000	Total		147,609,592
Sweden	1917	573,018	Estimate in "Cotton Facts"		151,200,000
Other European Countries	–	333,363	Estimate of Commercial and Financial Chronicle	1918	147,081,748
Egypt	1918	20,000	U. S. Census estimate	1914	146,397,000
Asia Minor	1918	41,000			
India	1918	6,839,877			

TOTAL NUMBER OF COTTON SPINDLES, AND NUMBER ACTIVE, BY SECTIONS: 1907–1918.

(United States Census Data.)

Season Ending	Total Spindles	Active Cotton Spindles			
		United States	Cotton-growing States	New England States	All Other States
1918	34,940,830	34,542,665	14,529,063	17,984,720	2,028,882
1917	34,221,252	33,888,835	14,155,758	17,760,968	1,972,109
1916	33,333,176	32,805,883	13,382,065	17,474,264	1,949,554
1915	32,840,730	31,964,235	12,955,712	17,100,615	1,907,908
1914	32,744,012	32,107,572	12,711,303	17,408,372	1,987,897
1913	32,149,617	31,519,766	12,227,226	17,311,451	1,981,089
1912	31,582,679	30,578,528	11,582,869	17,139,945	1,855,714
1911	30,803,662	29,522,597	11,084,623	16,510,981	1,926,993
1910	28,929,093	28,266,862	10,494,112	15,735,086	2,037,664
1909	28,573,435	28,018,305	10,429,200	15,591,851	1,997,254

NOTE: Great caution must be used in drawing conclusions from the above statistics of Active Cotton Spindles for the figures include every spindle active during the year specified, regardless of the period active. Compare with Consumption of Cotton statistics given on page 20.

TABLE SHOWING THE NUMBER OF MILLS REPORTING METHOD OF SALE WITH THE NUMBER OF SPINDLES AND LOOMS INCLUDED, AND THE NUMBER AND PERCENTAGE OF MILLS, SPINDLES, AND LOOMS WHOSE PRODUCT WAS SOLD DIRECT; 1916.

(Compiled from the Official American Textile Directory.)

1916	Mills Reporting Method of Sale	Mills Reporting Direct Sale	Spindles: Number Reported Method of Sale	Spindles: Number Reported Direct Sale	Looms: Number Reported Method of Sale	Looms: Number Reported Direct Sale	Percentage Reporting Direct Sale: Mills	Percentage Reporting Direct Sale: Spindles	Percentage Reporting Direct Sale: Looms
United States .	1,082	502	30,501,013	11,880,127	688,429	259,258	46	39	38
New England .	329	196	16,961,574	8,726,155	405,711	203,511	60	51	50
Maine	16	2	1,030,526	56,440	26,059	120	12	6	0
New Hampshire	19	5	1,480,264	697,760	42,774	23,787	29	47	55
Vermont . . .	1	1	109,666	109,666	2,470	2,470	100	100	100
Massachusetts .	178	109	10,876,707	5,862,018	238,319	118,230	61	54	50
Rhode Island .	73	50	2,398,615	1,305,099	53,382	28,777	79	54	54
Connecticut . .	42	29	1,065,796	695,172	42,707	30,127	79	65	71
South	575	123	10,767,449	1,807,724	217,019	13,947	24	17	6
No. Carolina .	225	61	3,391,061	784,236	54,083	3,700	29	23	67
So. Carolina .	131	11	4,246,791	108,976	104,446	552	8	2	00
Georgia . . .	111	34	2,192,441	718,544	41,723	8,253	30	33	19
Alabama . . .	48	17	937,154	195,968	16,767	1,442	35	21	8
Central	164	135	1,426,012	500,442	33,316	13,559	82	35	41
New York . .	33	26	740,990	233,958	15,957	2,498	79	31	17
New Jersey . .	20	14	392,854	97,914	4,494	1,645	70	25	37
Philadelphia .	78	73	85,042	71,954	8,937	7,997	94	85	89
Pennsylvania .	26	21	141,776	96,776	3,354	1,348	81	68	40
Maryland . .	7	1	65,350	000	574	71	14	0	12
All Other . . .	74	48	1,345,978	845,806	32,383	21,231	65	63	66
Arkansas . . .	1	0	7,080	000	164	000	0	0	0
California . .	1	1	40,000	40,000	450	450	100	100	100
Delaware . . .	1	1	7,360	7,360	253	253	100	100	100
Illinois	4	3	16,000	000	453	105	75	0	23
Indiana . . .	4	3	73,864	58,696	1,908	1,408	75	80	74
Kentucky . .	7	5	98,894	48,494	1,360	10	71	48	1
Louisiana . . .	3	3	82,000	82,000	2,213	2,213	100	100	100
Mississippi . .	11	9	117,888	97,888	3,001	2,355	82	83	78
Tennessee . .	17	6	306,596	72,744	5,196	970	35	23	19
Texas	11	6	104,584	59,512	2,905	1,667	54	57	62
Virginia . . .	9	6	488,600	376,000	14,778	11,678	67	77	79
Wisconsin . .	5	5	3,112	3,112	122	122	100	100	100

INDEX NUMBERS OF EMPLOYMENT AND OF PAY ROLL IN COTTON MANUFACTURING, JANUARY, 1915, TO MAY, 1918.

(United States Bureau of Labor Statistics Data.)
(January, 1915, = 100.)

Month and Year	Number on Pay Roll	Amount of Pay Roll	Per Cent Increase Per Capita Earnings
1915:			
January	100	100	00
February	100	104	4
March	101	107	6
April	101	105	4
May	102	106	4
June	101	101	0
July	101	101	0
August	100	102	2
September	99	103	4
October	100	96	—4
November	101	101	0
December	101	100	—1
1916:			
January	99	102	3
February	100	110	10
March	100	111	11
April	100	113	13
May	100	118	18
June	100	117	17
July	100	114	14
August	98	114	16
September	98	116	18
October	98	111	13
November	99	117	18
December	101	123	24
1917:			
January	100	123	23
February	100	125	25
March	100	127	27
April	99	124	25
May	99	129	30
June	99	137	38
July	99	137	38
August	97	131	35
September	97	135	39
October	97	137	41
November	99	156	58
December	100	163	63
1918:			
January	99	158	60
February	94	150	60
March	98	166	69
April	96	169	76
May	95	173	82

COMPARISON OF THE AVERAGE OUTPUT PER SPINDLE PER WEEK, FOR A NORTHERN SPINNING MILL, FOR A SIX-MONTHS' PERIOD ENDING APRIL 29, 1916, UNDER A 58-HOUR WEEK, WITH THAT FOR SIMILAR PERIODS ENDING APRIL 28, 1917, AND APRIL 27, 1918, UNDER A 54-HOUR WEEK.

Size of Yarns	Average Pounds per Spindle per Week			Percentage Change	
	First Period 58 Hours	Second Period 54 Hours	Third Period 54 Hours	Between 1st and 2nd Periods	Between 2nd and 3d Periods
3	13.80	11.84	11.38	—14.2	—3.9
7	6.54	5.84	5.62	—10.7	—3.8
8	5.68	5.18	5.01	— 8.8	—3.3
12	4.04	3.69	4.01	— 8.7	+8.7
15	3.00	2.71	2.81	— 9.7	+3.7
19	2.44	2.15	—	—11.9	
20	1.97	1.74	1.84	—11.7	+5.8
24	1.57	1.34	1.34	—14.6	
26	1.32	1.28	1.24	— 3.0	—3.1
30	1.21	1.12	1.16	— 7.4	+3.6
33	1.02	.97	—	— 4.9	
40	.80	.76	.78	— 5.0	+2.6
45	.68	.60	.61	—11.8	+1 6
60	.50	.47	—	— 6.0	
80	.34	.33	—	— 2.9	

CONVERSION TABLE OF NUMBERING FOR COTTON YARN.

Metric Number	English Number	French Number	Austrian Number	Netherlands Number
1.	0.59	0.5	0.483	0.651
1.694	1.	0.8475	0.818	1.103
2.	1.18	1.	0.966	1.302
2.07	1.222	1.035	1.	1.3478
1.535	0.90629	.768	.74193	1.

STEAM PIPE COVERINGS

The importance and necessity of effectively insulating heating surfaces is becoming more and more appreciated. Frequently the question arises as to what material will be used and, what is of even greater

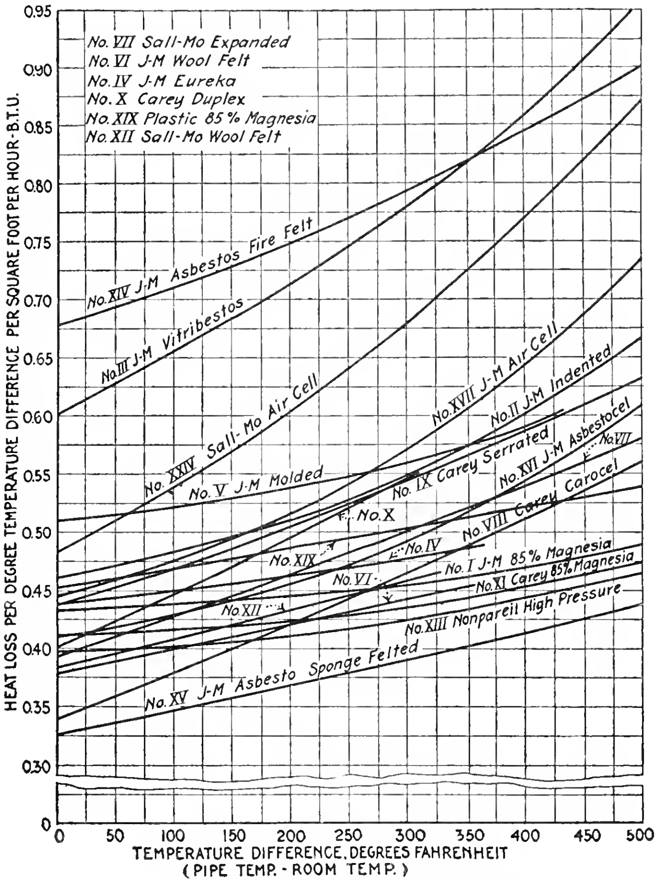

FIG. I. EFFECT OF CHARACTER OF COVERING

importance, what thickness of material shall be used for the greatest economy.

The three factors most important in determining the amount of heat transmitted by given insulating material are: (1) the character of the material, that is, its conductivity; (2) the temperature difference between its two boundaries; (3) the thickness of the layer of material.

The character of the surface and the velocity of the air fanning the surface are also factors to be considered, and in the case of tests conducted by L. B. McMillan and reported in the "Transactions" of the American Society of Mechanical Engineers, these were kept constant. The character of the material was varied by making tests of a number of different commercial pipe coverings of approximately the same thick-

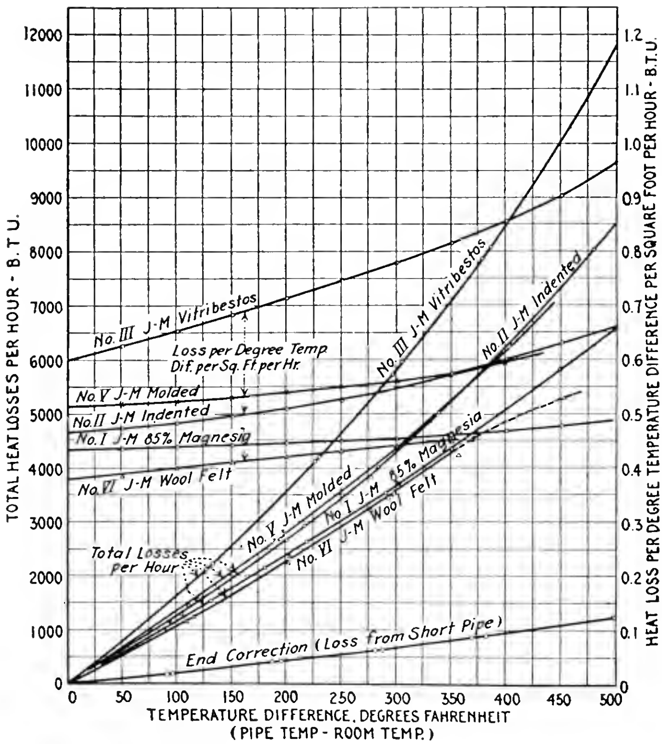

Fig. II. TESTS OF COVERINGS

ness and subjected to the same temperatures. The effect of the character of the material is shown in Figure I.

Tests were made at pipe temperatures ranging from 175° to 575° Fahrenheit. The effect of varying temperatures on the losses while the material and its thickness remained constant are shown in Figures 1 to 5. For two different materials the thickness was varied from 0″ to 3″ while the material and temperature range remained constant. The results of some of these tests are shown in Figures II. and III.

A brief description of the twenty-six coverings tested is given, the

recommendations as to the uses of the various coverings being those furnished by the manufacturers and not deductions from the results of the tests. The weight per foot is the average weight per lineal foot of 5″ covering and the thickness given is the average thickness.

I. J-M 85 Per Cent Magnesia. A molded sectional covering for use on high pressure steam pipes. Contains 85 per cent by weight of magnesium carbonate and the remainder is principally asbestos fiber. Weight per foot is 2.92 lb. and the thickness 1.08 in.

II. J-M Indented. Made up to layers of asbestos felt which has in

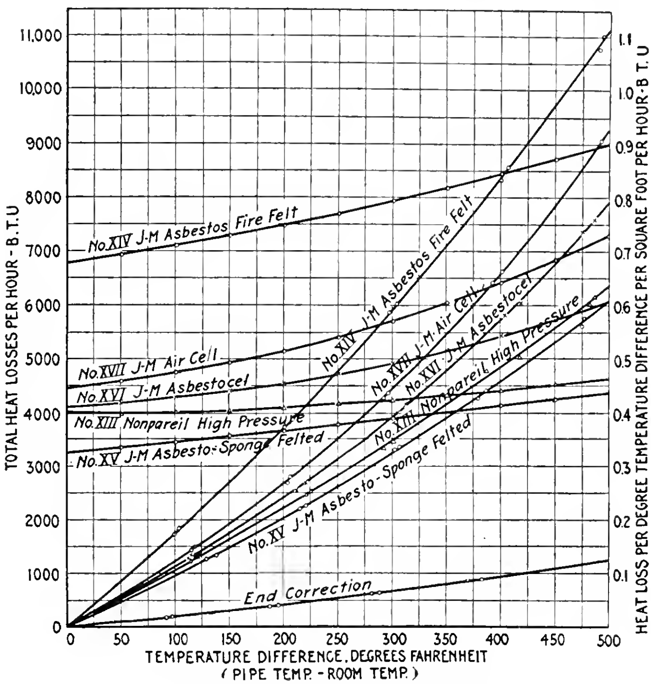

FIG. III. TESTS OF COVERINGS

it indentations, about $1\frac{1}{4}$ in. in diameter and $\frac{1}{8}$ in. deep, spaced very close to each other in staggered rows. Suitable for use on pipes containing high pressure steam. Weight per foot 3.46 lb. and thickness 1.12 in.

III. J-M Vitribestos. An asbestos air cell covering made of alternate layers of smooth and corrugated vitrified asbestos sheets. Corrugations are about $\frac{1}{4}$ in. deep and run lengthwise of the pipe. Recommended for use on high pressure and superheated steam pipes and for stack linings, etc. Weight per foot 4.05 lb. and thickness 0.96 in.

IV. J-M Eureka. For use on low pressure steam and hot water pipes. Made of $\frac{1}{4}$-in. of asbestos felt on the inside of the section and the

balance of alternate layers of asbestos and wool felt. Weight 4.60 lb. per ft. and is 1.04 in. thick.

V. J-M Molded Asbestos. A molded sectional covering for use on low and medium pressure steam pipes. Made of asbestos fiber and

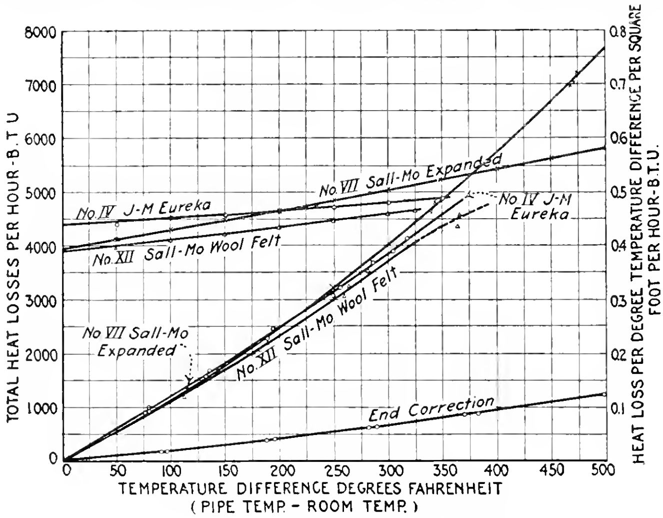

Fig. XI. TESTS OF COVERINGS

other fireproof material. Weight per ft. 5.53 lb. and thickness is 1.25 in.

VI. J-M Wool Felt. A sectional covering made of layers of wool

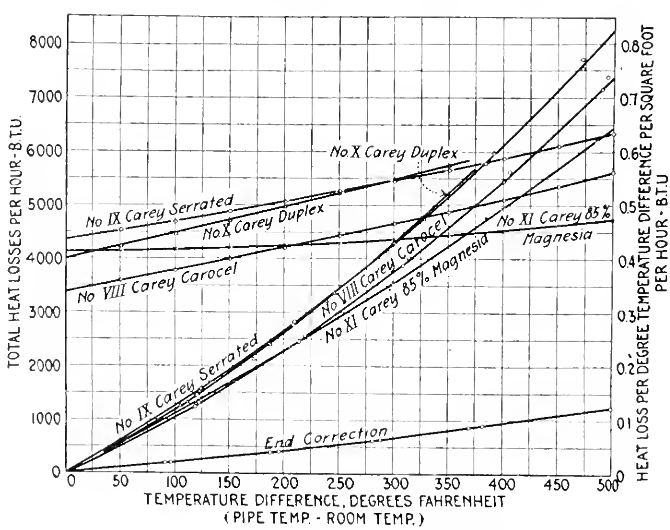

Fig. V. TESTS OF COVERINGS

felt with an interlining of two layers of asbestos paper. May be used on low pressure steam and hot water pipes. Weight per ft. 2.59 lb. and thickness $\frac{1}{16}$ in.

VII. Sall-Mo Expanded. A covering for use on high and low pressure steam pipes. Made of eight layers of material, each consisting of a smooth and a corrugated piece of asbestos paper, the corrugations

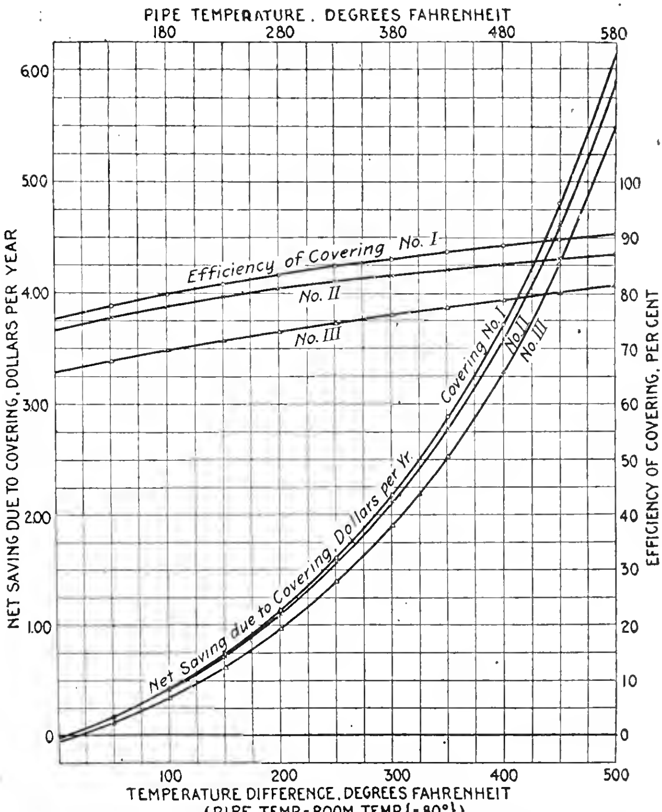

FIG. IV. EFFICIENCY AND NET SAVINGS CURVES OF COVERINGS I, II, AND III

being so crushed down to form small longitudinal air spaces. Weight 3.47 lb. per ft. and thickness 1.07 in.

VIII. Carey Carocel. Composed of plain and corrugated asbestos paper firmly bound together. Corrugations are approximately $\frac{1}{8}$ in. deep and run lengthwise of the pipe. For use on medium and low pressure steam pipes. Weight 3.06 lb. per ft. and thickness 0.99 in.

IX. Carey Serrated. A covering for use on high pressure steam pipes. Composed of successive layers of heavy asbestos felt having closely spaced indentations in it. Weight 5.66 lb. per ft. and thickness 1.00 in.

X. Carey Duplex. For use on low pressure steam and hot water pipes. Made of alternate layers of plain wool felt and corrugated asbestos paper firmly bound together. Corrugations run lengthwise of the pipe and make air cells approximately $\frac{1}{4}$ in. deep. Weight is 1.79 lb. per ft. and 0.96 in. thick.

XI. Carey 85 Per Cent Magnesia. A covering for high pressure steam and similar in composition to No. I. Weight per foot 2.74 lb. and thickness is 1.10 in.

XII. Sall-Mo Wool Felt. Similar to No. VI except that it has no interlining of asbestos paper. For use on low pressure steam and hot water pipes. Weight per foot 3.73 lb. and thickness is 1.01 in.

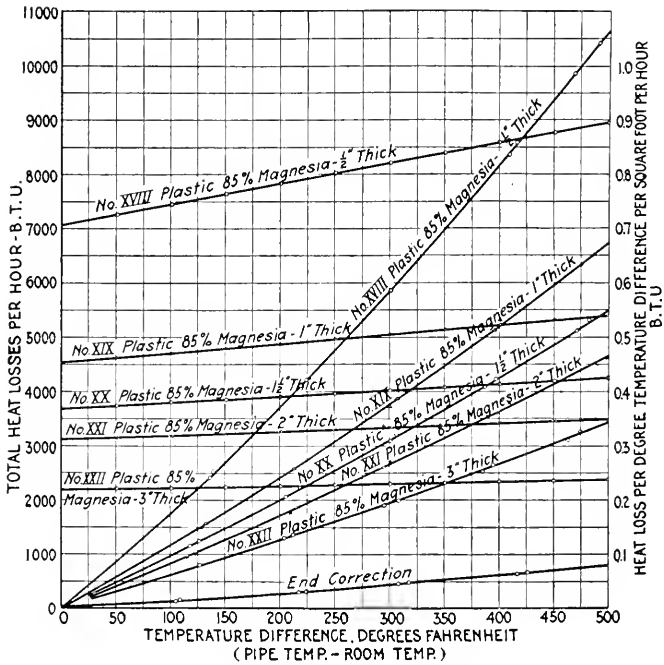

FIG. VI. TESTS OF COVERINGS

XIII. Nonpareil High Pressure. A molded sectional covering consisting mainly of silica in the form of diatomaceous earth—the skeletons of microscopic organisms. For use on high pressure and superheated steam pipes. Weight 2.96 lb. per ft. and is 1.16 in. thick.

XIV. J-M Asbestos Fire Felt. Consists of asbestos fiber loosely felted together, forming a large number of small air spaces. For use on high pressure and superheated steam pipes. Weight per ft. is 3.75 lb. and thickness 0.99 in.

XV. J-M Asbestos—Sponge Felted. Covering is made from a thin felt of asbestos fiber and finely ground sponge forming a very cellular fabric. Made up of 41 of these sheets per in. thickness and air spaces

are formed between the sheets in addition to those in the felt itself. Specially recommended for high pressure and superheated steam pipes. Weight per ft. 4.04 lb. and thickness 1.16 in.

XVI. J-M Asbestocel. For use on medium pressure steam and

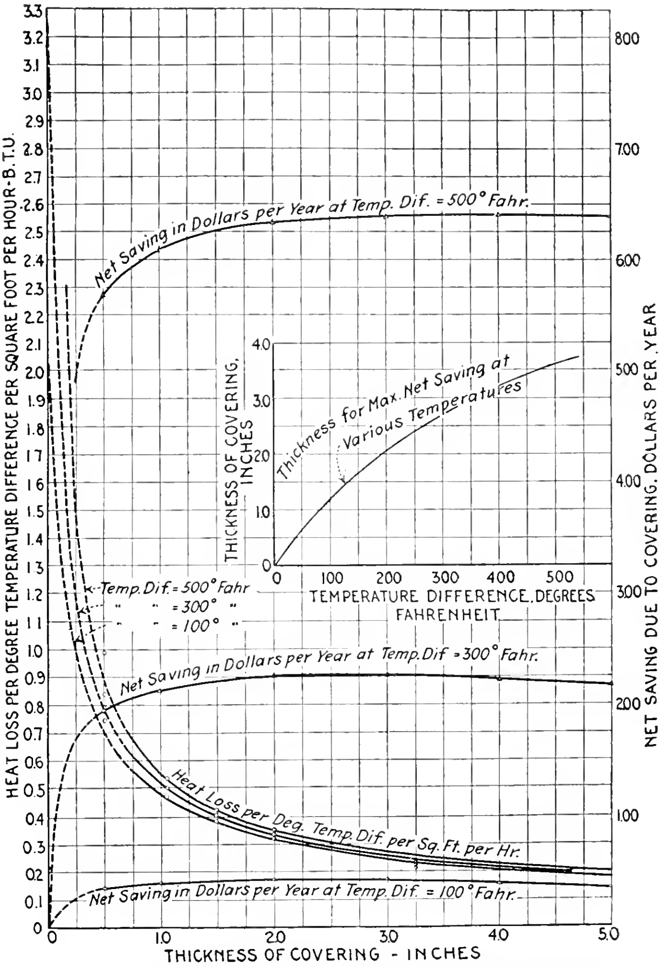

FIG. VII. SAVINGS WITH 85% MAGNESIA COVERING

heating pipes. Consists of alternate sheets of corrugated and plain asbestos paper forming air cells about $\frac{1}{8}$ in. deep that run around the pipe. Weight per ft. 1.94 lb. and thickness 1.10 in.

XVII. J-M Air Cell. Made of corrugated and plain sheets of asbestos paper arranged alternately so as to form air cells about $\frac{1}{4}$ in. deep running lengthwise of the pipe. For use on medium pressure

steam and heating pipes. Its weight per ft. is 1.55 lb. and thickness is 1.00 in.

XVIII. ½-in. J-M Plastic 85 Per Cent Magnesia. For use on fittings, valves, irregular surfaces, boiler coverings, etc. Similar in composition to the sectional 85 per cent magnesia, but applied in the form of a cement or plaster. Thickness was 0.51 in. for the first test and weight per ft. was 1.51 lb.

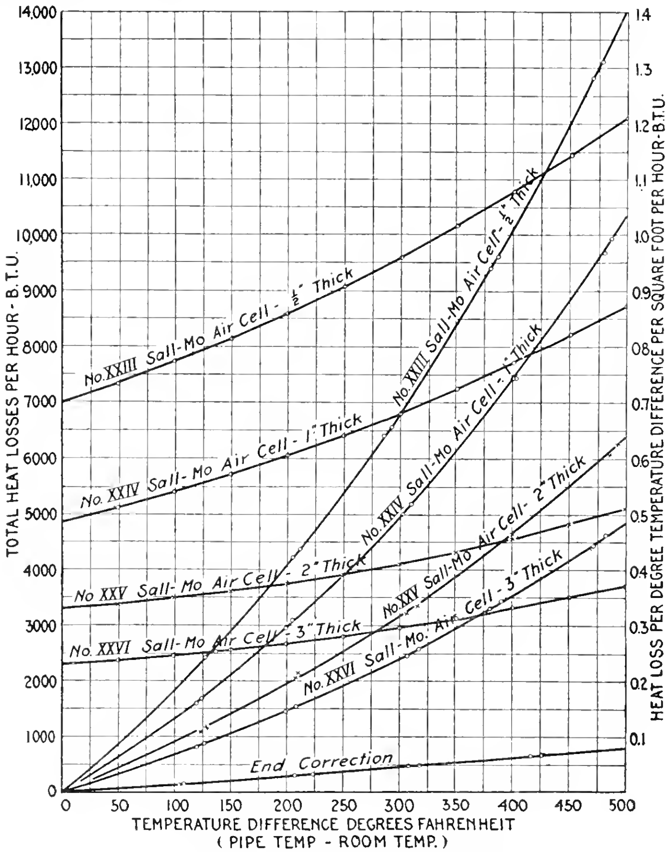

FIG. VIII. TESTS OF COVERINGS

XIX. 1-in. J-M Plastic 85 Per Cent Magnesia. Thickness 1.05 in., weight per ft. 3.33 lb.

XX. 1½-in. J-M Plastic 85 Per Cent Magnesia. Thickness 1.48 in., weight per ft. 5.23 lb.

XXI. 2-in. J-M Plastic 85 Per Cent Magnesia. Thickness 1.99 in., weight per ft. 7.46 lb.

XXII. 3-inch. J-M 85 Per Cent Magnesia. Consisted of the two inches of plastic covering of No. XXI and one standard thickness layer

of sectional covering outside of that. Thickness 3.24 in., weight per ft. 11.67 lb.

XXIII. ½-in. Sall-Mo Air Cell. This covering is similar in com-

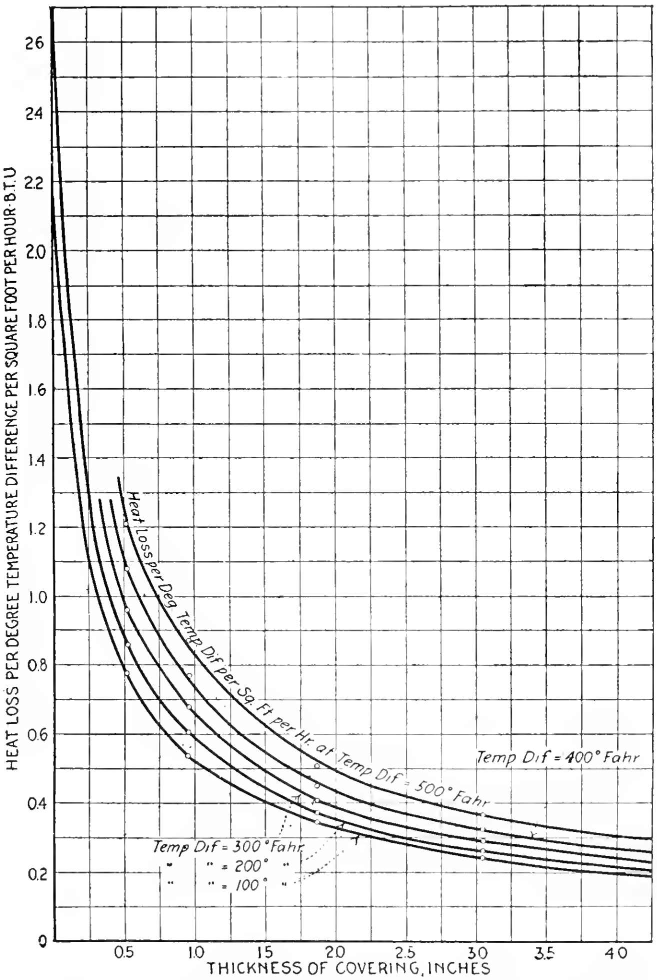

FIG. IX. HEAT LOSS CURVES WITH DIFFERENT THICKNESSES OF SALL-MO AIR CELL COVERINGS

position and uses to No. XVII. Its thickness is 0.51 in. and its weight per ft. is 0.99 lb.

XXIV. 1-in. Sall-Mo Air Cell. Thickness 0.95 in., weight per ft. 1.57 lb.

XXV. 2-in. Sall-Mo Air Cell. Thickness 1.86 in., weight per ft. 3.58 lb.

XXVI. 3-in. Air Cell. Consisted of two inches of Sall-Mo and one inch of J-M Air Cell. Thickness 3.04 in., weight per ft. 6.66 lb.

The Figures of tests of coverings show curves from tests of seventeen different coverings of single thickness, that is about 1″. The heat losses per degree temperature difference per square foot per hour in each figure refers to square feet of pipe surface and not of covering surface. The net heat loss curves from all the tests of coverings 1″ thick are assembled in the form of a general summary, Figure I, and from the curves shown in this figure it is evident that of all the coverings tested the four best, at temperatures of from 200° to 600° Fahrenheit, are J-M Asbestos-Sponge Felted, Nonpareil High Pressure, Carey 85 Per Cent Magnesia and J-M 85 Per Cent Magnesia, ranking in the order named, with the

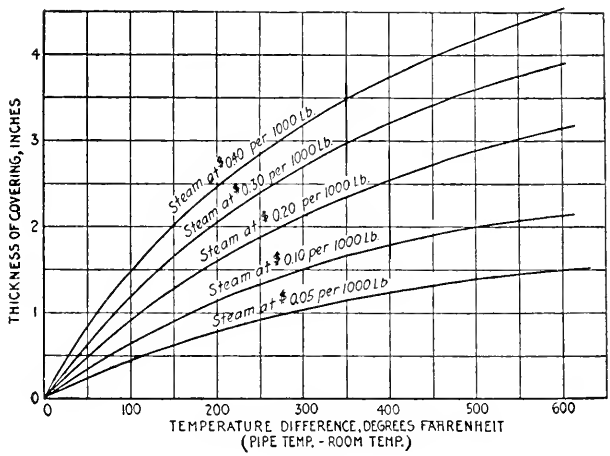

Fig. X.

first well ahead of all the others. Those losing the greatest amount of heat were J-M Vitribestos and J-M Asbestos Fire Felt. The first of these latter two is but little used for pipe coverings, being employed mostly for stack lining, etc., while the second is chiefly valuable as heatproof material suitable for use as the layer in contact with a pipe carrying superheated steam where the better insulating material used for the outer layers could not withstand the temperatures of superheat.

The saving in dollars per year due to the use of covering has been calculated for each of the coverings tested and the results given in Table 1. Efficiencies of all the coverings tested are also shown in the same table. Figure VI. shows the data given in Table 2 plotted in the form of curves for the first three coverings tested. The results of $\frac{1}{2}$″, 1″, 2″ and 3″ thicknesses of plastic 85 per cent magnesia are given

in Figure VI. Figure VII. shows the variation of losses with thickness at temperature differences of 100°, 300° and 500° Fahrenheit and for thicknesses from 0″ to 5″ as well as the proper thickness for the maximum net saving at any temperature difference from 0° to 500°. Figures VIII. and IX. show results of similar tests on different thicknesses of air cell covering.

Figure X. is a chart showing the proper thickness of magnesia covering to be used at any temperature, any price of steam and any number of hours service per year. The chart does not show values for length of service, but to use it for other periods than 365 days at 24 hours a day, multiply the price of steam by the number of hours per year the line considered is in service and divide by 8760 and, using the result as the price of steam on the chart, find the proper thickness. For example, suppose that the steam pressure is 150 lb. per square inch gage, that it costs $0.30 per 1000 lb. generated, and that the line is in use 12 hours a day and 9 months of the year. The number of hours per year that the steam is on is therefore 2920, or one-third of the time. The price of steam to be used on the chart is 0.30 (2920 divided by 8760) = $0.10. The temperature of the pipe containing steam at 150 lb. gage pressure will be about 365°. Assuming a room temperature of 80°, the temperature difference between pipe and room will be 285°. Now on the chart, using the curve for steam at $0.10 per 1000 lb., the proper thickness corresponding to 285° temperature difference will be found to be 1.5 in., which is the proper thickness for maximum net saving under the given conditions (Table 1). See pages 52 and 53.

TABLE 1. DATA ON EFFICIENCIES AND SAVINGS FOR SINGLE THICKNESS COVERINGS

(From A. S. M. E. Transactions, 1915)

Covering No.	Kind of Covering	Temperature Difference (Pipe and Room)	Actual Temperature (Room = 80 deg. fahr.)	B.t.u. Loss /Sq.ft./Deg Temperature Difference/Hr.		B.t.u. Saving Due to Covering/Deg./Sq. ft./Hr.	Efficiency of Covering—Per Cent	Saving Due to Covering in B.t.u./Sq. ft./Yr.	Saving in $/Sq. ft./Yr.	First Cost of Covering/Sq. ft.	Cost of Covering/Sq. ft./Yr.	Net Saving in $/Sq. ft./Yr.	Interest on Investment
				Bare Pipe	Covered Pipe								
I	J-M 85% Magnesia	50	130	1.950	0.435	1.515	77.7	664,000	0.199	0.238	0.033	0.166	69.7
		100	180	2.152	0.438	1.714	79.6	1,502,000	0.451			0.418	175.5
		200	280	2.665	0.446	2.219	83.3	3,887,000	1.165			1.132	475
		300	380	3.260	0.455	2.805	86.1	7,370,000	2.211			2.178	914
		400	480	4.035	0.469	3.566	88.4	12,490,000	3.750			3.717	1560
		500	580	5.180	0.488	4.692	90.6	20,560,000	6.165			6.132	2575
II	J-M Indented	50	130	1.950	0.472	1.478	75.6	647,300	0.194	0.214	0.030	0.164	76.6
		100	180	2.152	0.483	1.669	77.6	1,462,000	0.438			0.408	190.5
		200	280	2.665	0.509	2.156	80.9	3,777,000	1.133			1.103	515
		300	380	3.260	0.549	2.711	83.2	7,120,000	2.136			2.106	983
		400	480	4.035	0.603	3.432	85.1	12,020,000	3.608			3.578	1676
		500	580	5.180	0.666	4.514	87.1	19,780,000	5.935			5.905	2760
III	J-M Vitribestos	50	130	1.950	0.626	1.324	67.9	580,000	0.174	0.381	0.053	0.121	31.8
		100	180	2.152	0.654	1.498	69.6	1,312,000	0.394			0.341	89.6
		200	280	2.665	0.715	1.950	73.2	3,417,000	1.025			0.972	255.0
		300	380	3.260	0.781	2.481	76.0	6,519,000	1.955			1.902	500.0
		400	480	4.035	0.858	3.177	78.8	11,130,000	3.340			3.287	865.0
		500	580	5.180	0.967	4.213	81.4	18,450,000	5.540			5.487	1442.0
IV	J-M Eureka	50	130	1.950	0.440	1.510	77.4	661,000	0.198	0.262	0.037	0.161	61.5
		100	180	2.152	0.451	1.701	79.0	1,490,000	0.447			0.410	156.6
		200	280	2.665	0.464	2.201	82.6	3,860,000	1.158			1.121	428.0
		300	380	3.260	0.478	2.782	85.4	7,310,000	2.192			2.155	824.0
		350	430	3.627	0.487	3.140	86.6	9,620,000	2.888			2.851	1090.0
V	J-M Molded	50	180	1.950	0.517	1.433	73.4	627,600	0.188	0.190	0.027	0.161	55.5
		100	180	2.152	0.522	1.630	75.8	1,428,000	0.428			0.401	211.0
		200	280	2.665	0.539	2.126	79.8	3,725,000	1.117			1.090	574.0
		300	380	3.260	0.561	2.699	82.8	7,088,000	2.126			2.099	1105.0
		400	480	4.035	0.596	3.439	85.2	12,050,000	3.615			3.588	1888.0
VI	J-M Wool-Felt	50	130	1.950	0.386	1.564	80.2	684,700	0.205	0.214	0.030	0.175	81.8
		100	180	2.152	0.400	1.752	81.4	1,535,000	0.460			0.430	201.0
		200	280	2.665	0.421	2.244	84.2	3,930,000	1.179			1.149	537.0
		300	380	3.260	0.442	2.818	86.4	7,400,000	2.220			2.190	1023.0
		350	430	3.627	0.453	3.174	87.6	9,730,000	2.919			2.889	1349.0
VII	Sall-Mo Expanded	50	130	1.950	0.409	1.541	79.0	674,600	0.202	0.248	0.035	0.167	67.3
		100	180	2.152	0.427	1.725	80.2	1,511,000	0.453			0.418	168.5
		200	280	2.665	0.464	2.201	82.6	3,856,000	1.156			1.121	452.0
		300	380	3.260	0.503	2.757	84.6	7,240,000	2.172			2.137	852.0
		400	480	4.035	0.541	3.494	86.6	12,240,000	3.672			3.637	1466.0
		500	580	5.180	0.581	4.599	88.8	20,140,000	6.042			6.007	2421.0
VIII	Carey Carocel	50	130	1.950	0.358	1.592	81.6	697,000	0.209	0.195	0.027	0.182	93.4
		100	180	2.152	0.378	1.774	82.4	1,555,000	0.467			0.440	226.0
		200	280	2.665	0.421	2.244	84.2	3,932,000	1.180			1.153	592.0
		300	380	3.260	0.466	2.794	85.7	7,340,000	2.202			2.175	1116.0
		400	480	4.035	0.510	3.525	87.4	12,350,000	3.705			3.678	1886.0
		500	580	5.180	0.562	4.618	89.2	20,220,000	6.066			6.039	3100.0
IX	Carey Serrated	50	130	1.950	0.454	1.496	76.7	655,000	0.197	0.214	0.030	0.167	78.0
		100	180	2.152	0.468	1.684	78.2	1,475,000	0.443			0.413	193.0
		200	280	2.665	0.506	2.159	81.0	3,782,000	1.135			1.105	517.0
		300	380	3.260	0.546	2.714	83.3	7,132,000	2.140			2.110	986.0
		400	480	4.035	0.587	3.448	85.4	12,075,000	3.622			3.592	1680.0
		500	580	5.180	0.634	4.546	87.8	19,900,000	5.970			5.940	2780.0

TABLE 1. DATA ON EFFICIENCIES AND SAVINGS FOR SINGLE THICKNESS COVERINGS—CONCLUDED

(From A. S. M. E. Transactions, 1915)

Covering No.	Kind of Covering	Temperature Difference (Pipe and Room)	Actual Temperature (Room = 80 deg. fahr.)	B.t.u. Loss /Sq.ft./Deg Temperature Difference/Hr.		B.t.u. Saving Due to Covering/Deg. Sq. ft./Hr.	Efficiency of Covering—Per Cent	Saving Due to Covering in B.t.u./Sq. ft./Yr.	Saving in $/Sq. ft./Yr.	First Cost of Covering/Sq. ft.	Cost of Covering/Sq. ft./Yr.	Net Saving in $/Sq. ft./Yr.	Interest on Investment
				Bare Pipe	Covered Pipe								
X	Carey Duplex	50	130	1.950	0.423	1.527	78.3	669,000	0.201	0.162	0.023	0.178	110.0
		100	180	2.152	0.447	1.705	79.2	1,494,000	0.448			0.425	252.0
		200	280	2.665	0.498	2.167	81.3	3,798,000	1.139			0.116	689.0
		300	380	3.260	0.548	2.712	83.2	7,128,000	2.140			0.117	1307.0
		350	430	3.627	0.574	3.053	84.2	9,360,000	2.808			2.785	1720.0
XI	Carey 85% Magnesia	50	130	1.950	0.413	1.537	78.8	673,000	0.202	0.200	0.028	0.174	87.0
		100	180	2.152	0.418	1.734	80.5	1,519,000	0.456			0.428	214.0
		200	280	2.665	0.424	2.241	84.1	3,929,000	1.179			1.151	576.0
		300	380	3.260	0.436	2.824	86.6	7,420,000	2.226			2.198	1099.0
		400	480	4.035	0.454	3.581	88.8	12,550,000	3.765			3.737	1869.0
		500	580	5.180	0.472	4.708	90.9	20,610,000	6.183			6.155	3078.0
XII	Sall-Mo Wool-Felt	50	130	1.950	0.395	1.555	79.8	681,000	0.204	0.190	0.027	0.177	93.3
		100	180	2.152	0.401	1.751	81.4	1,535,000	0.461			0.434	228.0
		150	230	2.400	0.421	1.979	82.5	2,600,000	0.780			0.753	396.5
		200	280	2.665	0.433	2.232	83.8	3,910,000	1.173			1.146	604.0
		250	330	2.951	0.445	2.506	84.9	5,484,000	1.645			1.618	852.0
		300	380	3.260	0.459	2.801	85.9	7,360,000	2.208			2.181	1150.0
XIII	Nonpareil High Pressure	50	130	1.950	0.399	1.551	79.5	679,000	0.204	0.224	0.031	0.173	77.2
		100	180	2.152	0.402	1.750	81.3	1,533,000	0.460			0.429	192.0
		200	280	2.665	0.412	2.253	84.6	3,950,000	1.185			1.154	516.0
		300	380	3.260	0.426	2.834	86.9	7,448,000	2.234			2.203	985.0
		400	480	4.035	0.444	3.591	89.0	12,580,000	3.774			3.745	1673.0
		500	580	5.180	0.465	4.715	91.0	20,640,000	6.190			6.159	2752.0
XIV	J-M Fire Felt	50	130	1.950	0.694	1.256	64.4	550,000	0.165			0.118	35.4
		100	180	2.152	0.711	1.441	67.0	1,262,000	0.379	0.333	0.047	0.332	99.7
		200	280	2.665	0.749	1.916	71.9	3,360,000	1.008			0.961	288.6
		300	380	3.260	0.795	2.465	75.6	6,480,000	1.944			1.897	570.0
		400	480	4.035	0.845	3.190	79.0	11,175,000	3.353			3.306	993.0
		500	580	5.180	0.901	4.279	82.6	18,740,000	5.620			5.573	1675.0
XV	J-M Sponge Felted	50	130	1.950	0.336	1.614	82.7	707,000	0.212	0.333	0.047	0.165	49.5
		100	180	2.152	0.347	1.805	83.8	1,581,000	0.474			0.427	128.0
		200	280	2.665	0.369	2.296	86.2	4,035,000	1.211			1.164	350.0
		300	380	3.260	0.391	2.869	88.0	7,540,000	2.262			2.215	665.0
		400	480	4.035	0.414	3.621	89.8	12,690,000	3.809			3.762	1132.0
		500	580	5.180	0.439	4.741	91.5	20,770,000	6.230			6.183	1860.0
XVI	J-M Asbestocel	50	130	1.950	0.418	1.532	78.5	671,000	0.201	0.262	0.037	0.164	62.7
		100	180	2.152	0.429	1.723	80.0	1,510,000	0.453			0.416	159.0
		200	280	2.665	0.454	2.211	83.0	3,876,000	1.163			1.126	430.0
		300	380	3.260	0.493	2.767	84.8	7,272,000	2.181			2.144	820.0
		400	480	4.035	0.544	3.491	86.5	12,230,000	3.670			3.633	1388.0
		500	580	5.180	0.609	4.571	88.2	20,020,000	6.006			5.969	2280.0
XVII	J-M Air Cell	50	130	1.950	0.459	1.491	76.4	653,000	0.196	0.190	0.027	0.169	89.0
		100	180	2.152	0.475	1.677	77.9	1,469,000	0.441			0.414	218.0
		200	280	2.665	0.515	2.150	80.7	3,769,000	1.130			1.103	581.0
		300	380	3.260	0.571	2.689	82.7	7,066,000	2.120			2.093	1101.0
		400	480	4.035	0.643	3.392	84.1	11,885,000	3.568			3.541	1865.0
		500	580	5.180	0.733	4.447	85.8	19,475,000	5.841			5.814	3060.0

ROVING TABLE

For numbering by the weight, in grains, of 12 yds.; and showing twist per inch.

Grains Weight	Hank Roving	Sq. Root	Twist Per In.	Grains Weight	Hank Roving	Sq. Root	Twist Per In.	Grains Weight	Hank Roving	Sq. Root	Twist Per In.
400.00	.25	.500	.60	147.06	.68	.825	.99	81.97	1.22	1.105	1.33
384.61	.26	.510	.61	144.93	.69	.831	1.00	80.65	1.24	1.114	1.34
370.37	.27	.520	.62	142.86	.70	.837	1.00	79.37	1.26	1.122	1.35
357.14	.28	.529	.63	140.85	.71	.843	1.01	78.12	1.28	1.131	1.36
344.83	.29	.539	.65	138.89	.72	.849	1.02	76.92	1.30	1.140	1.37
333.33	.30	.548	.66	135.99	.73	.854	1.02	75.76	1.32	1.149	1.38
322.58	.31	.557	.67	135.14	.74	.860	1.03	74.63	1.34	1.158	1.39
312.50	.32	.566	.68	133.33	.75	.866	1.04	75.53	1.36	1.166	1.40
303.03	.33	.574	.69	131.58	.76	.872	1.05	72.46	1.38	1.175	1.41
294.12	.34	.583	.70	129.87	.77	.874	1.05	71.43	1.40	1.183	1.42
285.71	.35	.592	.71	128.21	.78	.883	1.06	70.42	1.42	1.192	1.43
277.78	.36	.600	.72	126.58	.79	.889	1.07	69.44	1.44	1.200	1.44
270.27	.37	.608	.73	125.00	.80	.894	1.07	68.49	1.46	1.208	1.45
263.16	.38	.616	.74	123.46	.81	.900	1.08	67.57	1.48	1.217	1.46
256.41	.39	.624	.75	121.95	.82	.906	1.09	66.67	1.50	1.225	1.47
250.00	.40	.632	.76	120.48	.83	.911	1.09	65.79	1.52	1.233	1.48
243.90	.41	.640	.77	119.05	.84	.917	1.10	64.94	1.54	1.241	1.49
238.10	.42	.648	.78	117.65	.85	.922	1.11	64.10	1.56	1.249	1.50
232.56	.43	.656	.79	116.28	.86	.927	1.11	63.29	1.58	1.257	1.51
227.27	.44	.663	.80	114.94	.87	.933	1.12	62.50	1.60	1.265	1.52
222.22	.45	.671	.80	113.64	.88	.938	1.13	61.73	1.62	1.273	1.53
217.39	.46	.678	.81	112.36	.89	.943	1.13	60.98	1.64	1.281	1.54
212.77	.47	.686	.82	111.11	.90	.949	1.14	60.24	1.66	1.288	1.55
208.33	.48	.693	.83	109.89	.91	.954	1.14	59.52	1.68	1.296	1.56
204.08	.49	.700	.84	108.70	.92	.959	1.15	58.82	1.70	1.304	1.56
200.00	.50	.707	.85	107.53	.93	.964	1.16	58.14	1.72	1.311	1.57
196.08	.51	.714	.86	106.38	.94	.970	1.16	57.47	1.74	1.319	1.58
192.31	.52	.721	.87	105.26	.95	.975	1.17	56.82	1.76	1.327	1.59
188.68	.53	.728	.87	104.17	.96	.980	1.18	56.18	1.78	1.334	1.60
185.19	.54	.735	.88	103.09	.97	.985	1.18	55.56	1.80	1.342	1.61
181.82	.55	.742	.89	102.04	.98	.990	1.19	54.95	1.82	1.349	1.62
178.57	.56	.748	.90	101.01	.99	.995	1.19	54.35	1.84	1.356	1.63
175.44	.57	.755	.91	100.00	1.00	1.000	1.20	53.76	1.86	1.364	1.64
172.41	.58	.762	.91	98.04	1.02	1.010	1.21	53.19	1.88	1.371	1.65
169.49	.59	.768	.92	96.15	1.04	1.020	1.22	52.63	1.90	1.378	1.65
166.67	.60	.775	.93	94.34	1.06	1.030	1.24	52.08	1.92	1.386	1.66
163.93	.61	.781	.94	92.59	1.08	1.039	1.25	51.55	1.04	1.393	1.67
161.29	.62	.787	.94	90.91	1.10	1.049	1.26	51.02	1.96	1.400	1.68
158.73	.63	.794	.95	89.29	1.12	1.058	1.27	50.51	1.98	1.407	1.69
156.25	.64	.800	.96	87.72	1.14	1.068	1.28	50.00	2.00	1.414	1.70
153.85	.65	.806	.97	86.21	1.16	1.077	1.29	49.50	2.02	1.421	1.71
151.52	.66	.812	.97	84.75	1.18	1.086	1.30	49.02	2.04	1.428	1.71
149.25	.67	.819	.98	83.33	1.20	1.095	1.31	48.54	2.06	1.435	1.72

ROVING TABLE (continued)

For numbering by the weight, in grains, of 12 yds.; and showing twist per inch.

Grains Weight	Hank Roving	Sq. Root	Twist Per In.	Grains Weight	Hank Roving	Sq. Root	Twist Per In.	Grains Weight	Hank Roving	Sq. Root	Twist Per In.
48.08	2.08	1.442	1.73	34.01	2.94	1.715	2.06	14.29	7.00	2.646	3.17
47.62	2.10	1.449	1.74	33.78	2.96	1.721	2.07	14.08	7.10	2.665	3.20
47.17	2.12	1.456	1.75	33.56	2.98	1.726	2.07	13.89	7.20	2.683	3.22
46.73	2.14	1.463	1.76	33.33	3.00	1.732	2.08	13.70	7.30	2.702	3.24
46.30	2.16	1.470	1.76	32.26	3.10	1.761	2.11	13.51	7.40	2.720	3.26
45.87	2.18	1.476	1.77	31.25	3.20	1.789	2.15	13.33	7.50	2.739	3.29
45.45	2.20	1.483	1.78	30.30	3.30	1.817	2.18	13.16	7.60	2.757	3.31
45.05	2.22	1.490	1.79	29.41	3.40	1.844	2.21	12.99	7.70	2.775	3.33
44.64	2.24	1.497	1.80	28.57	3.50	1.871	2.24	12.82	7.80	2.793	3.35
44.25	2.26	1.503	1.80	27.78	3.60	1.897	2.28	12.66	7.90	2.811	3.37
43.86	2.28	1.510	1.81	27.03	3.70	1.924	2.31	12.50	8.00	2.828	3.39
43.48	2.30	1.517	1.82	26.32	3.80	1.949	2.34	12.35	8.10	2.846	3.42
43.10	2.32	1.523	1.83	25.64	3.90	1.975	2.37	12.20	8.20	2.864	3.44
42.74	2.34	1.530	1.84	25.00	4.00	2.000	2.40	12.05	8.30	2.881	3.46
42.37	2.36	1.536	1.84	24.39	4.10	2.025	2.43	11.90	8.40	2.898	3.48
42.02	2.38	1.543	1.85	23.81	4.20	2.049	2.46	11.76	8.50	2.915	3.50
41.67	2.40	1.549	1.86	23.26	4.30	2.074	2.49	11.63	8.60	2.933	3.52
41.32	2.42	1.556	1.87	22.73	4.40	2.098	2.52	11.49	8.70	2.950	3.54
40.98	2.44	1.562	1.87	22.22	4.50	2.121	2.55	11.36	8.80	2.966	3.56
40.65	2.45	1.568	1.88	21.74	4.60	2.145	2.57	11.24	8.90	2.983	3.58
40.32	2.48	1.575	1.89	21.28	4.70	2.168	2.60	11.11	9.00	3.000	3.60
40.00	2.50	1.581	1.90	20.83	4.80	2.191	2.63	10.99	9.10	3.017	3.62
39.68	2.52	1.587	1.90	20.41	4.90	2.214	2.66	10.87	9.20	3.033	3.64
39.37	2.54	1.594	1.91	20.00	5.00	2.236	2.68	10.75	9.30	3.050	3.66
39.06	2.56	1.600	1.92	19.61	5.10	2.258	2.71	10.64	9.40	3.066	3.68
38.76	2.58	1.606	1.93	19.23	5.20	2.280	2.74	10.53	9.50	3.082	3.70
38.46	2.60	1.612	1.93	18.87	5.30	2.302	2.76	10.42	9.60	3.098	3.72
38.17	2.62	1.619	1.94	18.52	5.40	2.324	2.76	10.31	9.70	3.114	3.74
37.88	2.64	1.625	1.95	18.18	5.50	2.345	2.81	10.20	9.80	3.130	3.76
37.59	2.66	1.631	1.96	17.86	5.60	2.366	2.84	10.10	9.90	3.146	3.78
37.31	2.68	1.637	1.96	17.54	5.70	2.387	2.86	10.00	10.00	3.162	3.79
37.04	2.70	1.643	1.97	17.24	5.80	2.408	2.89	9.09	11.00	3.317	3.98
36.76	2.72	1.649	1.98	16.95	5.90	2.429	2.91	8.33	12.00	3.464	4.16
36.50	2.74	1.655	1.99	16.67	6.00	2.449	2.94	7.69	13.00	3.606	4.33
36.23	2.76	1.661	1.99	16.39	6.10	2.470	2.96	7.14	14.00	3.742	4.49
35.97	2.78	1.667	2.00	16.13	6.20	2.490	2.99	6.67	15.00	3.873	4.65
35.71	2.80	1.673	2.01	15.87	6.30	2.510	3.01	6.25	16.00	4.000	4.80
35.46	2.82	1.679	2.01	15.62	6.40	2.530	3.04	5.88	17.00	4.123	4.95
35.21	2.84	1.685	2.02	15.38	6.50	2.550	3.06	5.56	18.00	4.243	5.09
34.97	2.86	1.691	2.03	15.15	6.60	2.569	3.08	5.26	19.00	4.359	5.23
34.72	2.88	1.697	2.04	14.93	6.70	2.588	3.11	5.00	20.00	4.472	5.37
34.48	2.90	1.703	2.04	14.71	6.80	2.608	3.13				
34.25	2.92	1.709	2.05	14.49	6.90	2.627	3.15				

YARN TABLE

For numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn
1.	1000.	13.	76.92	19.	52.63	25.	40.00	31.	32.26	37.	27.03	43.	23.26	49.	20.41
2.	500.	.1	76.34	.1	52.36	.1	39.84	.1	32.16	.1	26.95	.1	23.20	.1	20.37
3.	333.3	.2	75.76	.2	52.08	.2	39.68	.2	32.05	.2	26.88	.2	23.15	.2	20.33
4.	250.0	.3	75.19	.3	51.81	.3	39.53	.3	31.95	.3	26.81	.3	23.09	.3	20.28
5.	200.0	.4	74.63	.4	51.55	.4	39.37	.4	31.85	.4	26.74	.4	23.04	.4	20.24
5.5	181.8	.5	74.07	.5	51.28	.5	39.22	.5	31.75	.5	26.67	.5	22.99	.5	20.20
6.	166.7	.6	73.53	.6	51.02	.6	39.06	.6	31.65	.6	26.60	.6	22.94	.6	20.16
6.5	153.8	.7	72.99	.7	50.76	.7	38.91	.7	31.55	.7	26.53	.7	22.88	.7	20.12
7.	142.9	.8	72.46	.8	50.51	.8	38.76	.8	31.45	.8	26.46	.8	22.83	.8	20.08
7.5	133.3	.9	71.94	.9	50.25	.9	38.61	.9	31.35	.9	26.39	.9	22.78	.9	20.04
8.	125.0	14.	71.43	20.	50.00	26.	38.46	32.	31.25	38.	26.32	44.	22.73	50.	20.00
.1	123.5	.1	70.92	.1	49.75	.1	38.31	.1	31.15	.1	26.25	.1	22.68	.1	19.96
.2	122.0	.2	70.42	.2	49.50	.2	38.17	.2	31.06	.2	26.18	.2	22.62	.2	19.92
.3	120.5	.3	69.93	.3	49.26	.3	38.02	.3	30.96	.3	26.11	.3	22.57	.3	19.88
.4	119.0	.4	69.44	.4	49.02	.4	37.88	.4	30.86	.4	26.04	.4	22.52	.4	19.84
.5	117.6	.5	68.97	.5	48.78	.5	37.74	.5	30.77	.5	25.97	.5	22.47	.5	19.80
.6	116.3	.6	68.49	.6	48.54	.6	37.59	.6	30.67	.6	25.91	.6	22.42	.6	19.76
.7	114.9	.7	68.03	.7	48.31	.7	37.45	.7	30.58	.7	25.84	.7	22.37	.7	19.72
.8	113.6	.8	67.57	.8	48.08	.8	37.31	.8	30.49	.8	25.77	.8	22.32	.8	19.69
.9	112.4	.9	67.11	.9	47.85	.9	37.17	.9	30.40	.9	25.71	.9	22.27	.9	19.65
9.	111.1	15.	66.67	21.	47.62	27.	37.04	33.	30.30	39.	25.64	45.	22.22	51.	19.61
.1	109.9	.1	66.23	.1	47.33	.1	36.90	.1	30.21	.1	25.58	.1	22.17	.1	19.57
.2	108.7	.2	65.79	.2	47.17	.2	36.77	.2	30.12	.2	25.51	.2	22.12	.2	19.53
.3	107.5	.3	65.36	.3	46.95	.3	36.63	.3	30.03	.3	25.45	.3	22.08	.3	19.49
.4	106.4	.4	64.94	.4	46.73	.4	36.50	.4	29.94	.4	25.38	.4	22.03	.4	19.46
.5	105.3	.5	64.52	.5	46.51	.5	36.36	.5	29.85	.5	25.32	.5	21.98	.5	19.42
.6	104.2	.6	64.10	.6	46.30	.6	36.23	.6	29.76	.6	25.25	.6	21.93	.6	19.38
.7	103.1	.7	63.69	.7	46.08	.7	36.10	.7	29.67	.7	25.19	.7	21.88	.7	19.34
.8	102.0	.8	63.29	.8	45.87	.8	35.97	.8	29.59	.8	25.13	.8	21.83	.8	19.31
.9	101.0	.9	62.89	.9	45.66	.9	35.84	.9	29.50	.9	25.06	.9	21.79	.9	19.27

YARN TABLE (continued)

For numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

10.	100.0	16.	62.50	22.	45.45	28.	35.71	34.	29.41	40.	25.00	46.	21.74	52.	19.23
.1	99.01	.1	62.11	.1	45.25	.1	35.59	.1	29.33	.1	24.94	.1	21.69	.1	19.19
.2	98.04	.2	61.73	.2	45.05	.2	35.46	.2	29.24	.2	24.88	.2	21.65	.2	19.16
.3	97.09	.3	61.35	.3	44.84	.3	35.34	.3	29.15	.3	24.81	.3	21.60	.3	19.12
.4	96.15	.4	60.98	.4	44.64	.4	35.21	.4	29.07	.4	24.75	.4	21.55	.4	19.08
.5	95.24	.5	60.61	.5	44.44	.5	35.09	.5	28.99	.5	24.69	.5	21.51	.5	19.05
.6	94.34	.6	60.24	.6	44.25	.6	34.97	.6	28.90	.6	24.63	.6	21.46	.6	19.01
.7	93.46	.7	59.88	.7	44.05	.7	34.84	.7	28.82	.7	24.57	.7	21.41	.7	18.98
.8	92.59	.8	59.52	.8	43.86	.8	34.72	.8	28.74	.8	24.51	.8	21.37	.8	18.94
.9	91.74	.9	59.17	.9	43.67	.9	34.60	.9	28.65	.9	24.45	.9	21.32	.9	18.90
11.	90.91	17.	58.82	23.	43.48	29.	34.48	35.	28.57	41.	24.39	47.	21.28	53.	18.87
.1	90.09	.1	58.48	.1	43.29	.1	34.36	.1	28.49	.1	24.33	.1	21.23	.1	18.83
.2	89.29	.2	58.14	.2	43.10	.2	34.25	.2	28.41	.2	24.27	.2	21.19	.2	18.80
.3	88.50	.3	57.80	.3	42.92	.3	34.13	.3	28.33	.3	24.21	.3	21.14	.3	18.76
.4	87.72	.4	57.47	.4	42.74	.4	34.01	.4	28.25	.4	24.15	.4	21.10	.4	18.73
.5	86.96	.5	57.14	.5	42.55	.5	33.90	.5	28.17	.5	24.10	.5	21.05	.5	18.69
.6	86.21	.6	56.82	.6	42.37	.6	33.78	.6	28.09	.6	24.04	.6	21.01	.6	18.66
.7	85.47	.7	56.50	.7	42.19	.7	33.67	.7	28.01	.7	23.98	.7	20.96	.7	18.62
.8	84.75	.8	56.18	.8	42.02	.8	33.56	.8	27.93	.8	23.92	.8	20.92	.8	18.59
.9	84.03	.9	55.87	.9	41.84	.9	33.44	.9	27.86	.9	23.87	.9	20.88	.9	18.55
12.	83.33	18.	55.56	24.	41.67	30.	33.33	36.	27.78	42.	23.81	48.	20.83	54.	18.52
.1	82.64	.1	55.25	.1	41.49	.1	33.22	.1	27.70	.1	23.75	.1	20.79	.1	18.48
.2	81.97	.2	54.95	.2	41.32	.2	33.11	.2	27.62	.2	23.70	.2	20.75	.2	18.45
.3	81.30	.3	54.64	.3	41.15	.3	33.00	.3	27.55	.3	23.64	.3	20.70	.3	18.42
.4	80.65	.4	54.35	.4	40.98	.4	32.89	.4	27.47	.4	23.58	.4	20.66	.4	18.38
.5	80.00	.5	54.05	.5	40.82	.5	32.79	.5	27.40	.5	23.53	.5	20.62	.5	18.35
.6	79.37	.6	53.76	.6	40.65	.6	32.68	.6	27.32	.6	23.47	.6	20.57	.6	18.32
.7	78.74	.7	53.48	.7	40.49	.7	32.57	.7	27.25	.7	23.42	.7	20.53	.7	18.28
.8	78.12	.8	53.19	.8	40.32	.8	32.47	.8	27.17	.8	23.36	.8	20.49	.8	18.25
.9	77.52	.9	52.91	.9	40.16	.9	32.36	.9	27.10	.9	23.31	.9	20.45	.9	18.21

YARN TABLE (continued)

For numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn
55.	18.18	61.	16.39	67.	14.93	73.	13.70	79.	12.66	85.	11.76	91.	10.99	97.	10.31
.1	18.15	.1	16.37	.1	14.90	.1	13.68	.1	12.64	.1	11.75	.1	10.98	.1	10.30
.2	18.12	.2	16.34	.2	14.88	.2	13.66	.2	12.63	.2	11.74	.2	10.96	.2	10.29
.3	18.08	.3	16.31	.3	14.86	.3	13.64	.3	12.61	.3	11.72	.3	10.95	.3	10.28
.4	18.05	.4	16.29	.4	14.84	.4	13.62	.4	12.59	.4	11.71	.4	10.94	.4	10.27
.5	18.02	.5	16.26	.5	14.81	.5	13.61	.5	12.58	.5	11.70	.5	10.93	.5	10.26
.6	17.99	.6	16.23	.6	14.79	.6	13.59	.6	12.56	.6	11.68	.6	10.92	.6	10.25
.7	17.95	.7	16.21	.7	14.77	.7	13.57	.7	12.55	.7	11.67	.7	10.91	.7	10.24
.8	17.92	.8	16.19	.8	14.75	.8	13.55	.8	12.53	.8	11.66	.8	10.89	.8	10.22
.9	17.89	.9	16.16	.9	14.73	.9	13.53	.9	12.52	.9	11.64	.9	10.88	.9	10.21
56.	17.86	62.	16.13	68.	14.71	74.	13.51	80.	12.50	86.	11.63	92.	10.87	98.	10.20
.1	17.83	.1	16.10	.1	14.68	.1	13.50	.1	12.48	.1	11.61	.1	10.86	.1	10.19
.2	17.79	.2	16.08	.2	14.66	.2	13.48	.2	12.47	.2	11.60	.2	10.85	.2	10.18
.3	17.76	.3	16.05	.3	14.64	.3	13.46	.3	12.45	.3	11.59	.3	10.83	.3	10.17
.4	17.73	.4	16.03	.4	14.62	.4	13.44	.4	12.44	.4	11.57	.4	10.82	.4	10.16
.5	17.70	.5	16.00	.5	14.60	.5	13.42	.5	12.42	.5	11.56	.5	10.81	.5	10.15
.6	17.67	.6	15.97	.6	14.58	.6	13.40	.6	12.41	.6	11.55	.6	10.80	.6	10.14
.7	17.64	.7	15.95	.7	14.56	.7	13.39	.7	12.39	.7	11.53	.7	10.79	.7	10.13
.8	17.61	.8	15.92	.8	14.53	.8	13.37	.8	12.38	.8	11.52	.8	10.78	.8	10.12
.9	17.57	.9	15.90	.9	14.51	.9	13.35	.9	12.36	.9	11.51	.9	10.76	.9	10.11
57.	17.54	63.	15.87	69.	14.49	75.	13.33	81.	12.35	87.	11.49	93.	10.75	99.	10.10
.1	17.51	.1	15.85	.1	14.47	.1	13.32	.1	12.33	.1	11.48	.1	10.74	.1	10.09
.2	17.48	.2	15.83	.2	14.45	.2	13.30	.2	12.32	.2	11.47	.2	10.73	.2	10.08
.3	17.45	.3	15.80	.3	14.43	.3	13.28	.3	12.30	.3	11.45	.3	10.72	.3	10.07
.4	17.42	.4	15.77	.4	14.41	.4	13.26	.4	12.29	.4	11.44	.4	10.71	.4	10.06
.5	17.39	.5	15.75	.5	14.39	.5	13.25	.5	12.27	.5	11.43	.5	10.70	.5	10.05
.6	17.36	.6	15.72	.6	14.37	.6	13.23	.6	12.25	.6	11.42	.6	10.68	.6	10.04
.7	17.33	.7	15.70	.7	14.35	.7	13.21	.7	12.24	.7	11.40	.7	10.67	.7	10.03
.8	17.30	.8	15.67	.8	14.33	.8	13.19	.8	12.22	.8	11.39	.8	10.66	.8	10.02
.9	17.27	.9	15.65	.9	14.31	.9	13.18	.9	12.21	.9	11.38	.9	10.65	.9	10.01

YARN TABLE (continued)

For numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

58.	17.24	64.	15.62	70.	14.29	76.	13.16	82.	12.20	88.	11.36	94.	10.64	100.	10.00
.1	17.21	.1	15.60	.1	14.27	.1	13.14	.1	12.18	.1	11.35	.1	10.63	.1	9.99
.2	17.18	.2	15.58	.2	14.25	.2	13.12	.2	12.17	.2	11.34	.2	10.62	.2	9.98
.3	17.15	.3	15.55	.3	14.22	.3	13.11	.3	12.15	.3	11.33	.3	10.60	.3	9.97
.4	17.12	.4	15.53	.4	14.20	.4	13.09	.4	12.14	.4	11.31	.4	10.59	.4	9.96
.5	17.09	.5	15.50	.5	14.18	.5	13.07	.5	12.12	.5	11.30	.5	10.58	.5	9.95
.6	17.06	.6	15.48	.6	14.16	.6	13.05	.6	12.11	6	11.29	.6	10.57	.6	9.94
.7	17.04	.7	15.46	.7	14.14	.7	13.04	.7	12.09	.7	11.27	.7	10.56	.7	9.93
.8	17.01	.8	15.43	.8	14 12	.8	13.02	.8	12.08	.8	11.26	.8	10.55	.8	9.92
.9	16.98	.9	15.41	.9	14 10	.9	13.00	.9	12.06	.9	11.25	.9	10.54	.9	9.91
59.	16.95	65.	15.38	71.	14.08	77.	12.99	83.	12.05	89.	11.24	95.	10.53	101.	9.90
.1	16.92	.1	15.36	.1	14.06	.1	12.97	.1	12.03	.1	11.22	.1	10.52	.1	9.89
.2	16.89	.2	15.34	.2	14.04	.2	12.95	.2	12.02	.2	11.21	.2	10.50	.2	9.88
.3	16.86	.3	15.31	.3	14.03	.3	12.94	.3	12.00	.3	11.20	.3	10.49	.3	9.87
.4	16.84	.4	15.29	.4	14.01	.4	12.92	.4	11.99	.4	11 19	.4	10.48	.4	9.86
.5	16.81	.5	15.27	.5	13.99	.5	12.90	.5	11.98	.5	11.17	.5	10.47	.5	9.85
.6	16.78	.6	15.24	.6	13.97	.6	12.89	.6	11.96	.6	11.16	.6	10.46	.6	9.84
.7	16.75	.7	15.22	.7	13.95	.7	12.87	.7	11.95	.7	11.15	.7	10.45	.7	9.83
.8	16.72	.8	15.20	.8	13.93	.8	12.85	.8	11.93	.8	11.14	.8	10.44	.8	9.82
.9	16.69	.9	15.17	.9	13.91	.9	12.84	.9	11.92	.9	11.12	.9	10.43	.9	9.81
60.	16.67	66.	15.15	72.	13.89	78.	12.82	84.	11.90	90.	11.11	96.	10.42	102.	9.80
.1	16.64	.1	15.13	.1	13.87	.1	12.80	.1	11.89	.1	11.10	.1	10.41	.1	9.79
.2	16.61	.2	15.11	.2	13.85	.2	12.79	.2	11.88	.2	11.09	.2	10.40	.2	9.78
.3	16.58	.3	15.08	.3	13.83	.3	12.77	.3	11.86	.3	11.07	.3	10.38	.3	9.78
.4	16.56	.4	15.06	.4	13.81	.4	12.76	.4	11.85	.4	11.06	.4	10.37	.4	9.77
.5	16.53	.5	15.04	.5	13.79	.5	12.74	.5	11.83	.5	11.05	.5	10.36	.5	9.76
.6	16.50	.6	15.02	6	13.77	.6	12.72	.6	11.82	.6	11.04	.6	10.35	.6	9.75
.7	16.47	.7	14.99	.7	13.76	.7	12.71	.7	11.81	.7	11.03	.7	10.34	.7	9.74
.8	16.45	.8	14.97	8	13.74	.8	12.69	.8	11.79	.8	11.01	.8	10.33	.8	9.73
.9	16.42	.9	14.95	9	13.72	.9	12.67	.9	11.78	.9	11.00	.9	10.32	.9	9.72

YARN TABLE (continued)

For numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn	120 Yds. Weigh Grs.	Number of Yarn
103.	9.71	.5	9.22	119.	8.40	.5	7.02	170.	5.88	225.	4.44	310.	3.23	475.	2.11
.1	9.70	.6	9.21	.2	8.39	143.	6.99	171.	5.85	226.	4.42	212.	3.21	480.	2.08
.2	9.69	.7	9.20	.4	8.38	.5	6.97	172.	5.81	227.	4.41	314.	3.18	485.	2.06
.3	9.68	.8	9.19	.6	8.36	144.	6.94	173.	5.78	228.	4.39	316.	3.17	490.	2.04
.4	9.67	.9	9.18	.8	8.35	.5	6.92	174.	5.75	229.	4.37	318.	3.14	495.	2.02
.5	9.66	109.	9.17	120.	8.33	145.	6.90	175.	5.71	230.	4.35	320.	3.12	500.	2.00
.6	9.65	.2	9.16	.2	8.32	.5	6.87	176.	5.68	231.	4.33	322.	3.11	505.	1.98
.7	9.64	.4	9.14	.4	8.31	146.	6.85	177.	5.65	232.	4.31	324.	3.09	510.	1.96
.8	9.63	.6	9.12	.6	8.29	.5	6.83	178.	5.62	233.	4.29	326.	3.07	515.	1.94
.9	9.62	.8	9.11	.8	8.28	147.	6.80	179.	5.59	234.	4.27	328.	3.05	520.	1.92
104.	9.62	110.	9.09	121.	8.26	.5	6.78	180.	5.56	235.	4.26	330.	3.03	525.	1.90
.1	9.61	.2	9.07	.4	8.24	148.	6.76	181.	5.52	236.	4.24	332.	3.01	530.	1.89
.2	9.60	.4	9.06	.6	8.22	.5	6.73	182.	5.49	237.	4.22	334.	2.99	535.	1.87
.3	9.59	.6	9.04	.8	8.21	149.	6.71	183.	5.46	238.	4.20	336.	2.98	540.	1.85
.4	9.58	.8	9.03	122.	8.20	.5	6.69	184.	5.43	239.	4.18	338.	2.96	545.	1.83
.5	9.57	111.	9.01	.5	8.16	150.	6.67	185.	5.41	240.	4.17	340.	2.94	550.	1.82
.6	9.56	.2	8.99	123.	8.13	.5	6.64	186.	5.38	241.	4.15	342.	2.92	555.	1.80
.7	9.55	.4	8.98	.5	8.10	151.	6.62	187.	5.35	242.	4.13	344.	2.91	560.	1.79
.8	9.54	.6	8.96	124.	8.06	.5	6.60	188.	5.32	243.	4.12	346.	2.89	565.	1.77
.9	9.53	.8	8.94	.5	8.03	152.	6.58	189.	5.29	244.	4.10	348.	2.87	570.	1.75
105.	9.52	112.	8.93	125.	8.00	5	6.56	190.	5.26	245.	4.08	350.	2.86	575.	1.74
.1	9.51	.2	8.91	.5	7.97	153.	6.54	191.	5.24	246.	4.07	352.	2.84	580.	1.72
.2	9.51	.4	8.90	126.	7.94	.5	6.51	192.	5.21	247.	4.05	354.	2.82	585.	1.71
.3	9.50	.6	8.88	.5	7.91	154.	6.49	193.	5.18	248.	4.03	356.	2.81	590.	1.69
.4	9.49	.8	8.87	127.	7.87	.5	6.47	194.	4.15	249.	4.02	358.	2.79	595.	1.68
.5	9.48	113.	8.85	.5	7.84	155.	6.45	195.	5.13	250.	4.00	360.	2.78	600.	1.67
.6	9.47	.2	8.83	128.	7.81	.5	6.43	196.	5.10	252.	3.97	362.	2.76	610.	1.64
.7	9.46	.4	8.82	.5	7.78	156.	6.41	197.	5.08	254.	3.94	364.	2.75	620.	1.61
.8	9.45	.6	8.80	129.	7.75	.5	6.39	198.	5.05	256.	3.91	366.	2.73	630.	1.59
.9	9.44	.8	8.79	.5	7.72	157.	6.36	199.	5.03	258.	3.88	368.	2.72	640.	1.56

YARN TABLE (continued)

For numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

106.	9.43	114.	8.77	130.	7.69	.5	6.35	200.	5.00	260.	3.85	370.	2.70	650.	1.54
.1	9.43	.2	8.76	.5	7.66	158.	6.33	201.	4.98	262.	3.82	372.	2.69	660.	1.52
.2	9.42	.4	8.74	131.	7.63	.5	6.31	202.	4.95	264.	3.79	374.	2.67	670.	1.49
.3	9.41	.6	8.73	.5	7.60	159.	6.29	203.	4.93	266.	3.76	376.	2.66	680.	1.47
.4	9.40	.8	8.71	132.	7.58	.5	6.27	204.	4.90	268.	3.73	378.	2.65	690.	1.45
.5	9.39	115.	8.70	.5	7.55	160.	6.25	205.	4.88	270.	3.70	380.	2.63	700.	1.43
.6	9.38	.2	8.68	133.	7.52	.5	6.23	206.	4.85	272.	3.68	382.	2.62	710.	1.41
.7	9.37	.4	8.67	.5	7.49	161.	6.21	207.	4.83	274.	3.65	385.	2.60	720.	1.39
.8	9.36	.6	8.65	134.	7.46	.5	6.19	208.	4.81	276.	3.62	390.	2.56	730.	1.37
.9	9.35	.8	8.64	.5	7.43	162.	6.17	209.	4.78	278.	3.60	395.	2.53	740.	1.35
107.	9.35	116.	8.62	135.	7.41	.5	6.15	210.	4.76	280.	3.57	400.	2.50	750.	1.33
.1	9.34	.2	8.61	.5	7.38	163.	6.13	211.	4.74	282.	3.55	405.	2.47	760.	1.32
.2	9.33	.4	8.59	136.	7.35	.5	6.12	212.	4.72	284.	3.52	410.	2.44	770.	1.30
.3	9.32	.6	8.58	.5	7.33	164.	6.10	213.	4.69	286.	3.50	415.	2.41	780.	1.28
.4	9.31	.8	8.56	137.	7.30	.5	6.08	214.	4.67	288.	3.47	420.	2.38	790.	1.27
.5	9.30	117.	8.55	.5	7.27	165.	6.06	215.	4.65	290.	3.45	425.	2.35	800.	1.25
.6	9.29	.2	8.53	138.	7.25	.5	6.04	216.	4.63	292.	3.42	430.	2.33	820.	1.22
.7	9.29	.4	8.52	.5	7.22	166.	6.02	217.	4.61	294.	3.40	435.	2.30	840.	1.19
.8	9.28	.6	8.50	139.	7.19	.5	6.01	218.	4.59	296.	3.33	440.	2.27	860.	1.16
.9	9.27	.8	8.49	.5	7.17	167.	5.99	219.	4.57	298.	3.36	445.	2.25	880.	1.14
108.	9.26	118.	8.47	140.	7.14	.5	5.97	220.	4.55	300.	3.33	450.	2.22	900.	1.11
.1	9.25	.2	8.46	.5	7.12	168.	5.95	221.	4.52	302.	3.31	455.	2.20	925.	1.08
.2	9.24	.4	8.45	141.	7.09	.5	5.93	222.	4.50	304.	3.29	460.	2.17	950.	1.05
.3	9.23	.6	8.43	.5	7.07	169.	5.92	223.	4.48	306.	3.27	465.	2.15	975.	1.03
.4	9.23	.8	8.42	142.	7.04	.5	5.90	224.	4.46	308.	3.25	470.	2.13	1000.	1.00

YARN TABLE

For Numbering Yarn by the Weight, in Grains, of 840 Yards, or One Hank.

Number of Yarn	Grains Per Hank	Number of Yarn	Grains Per Hank	Number of Yarn	Grains Per Hank	Number of Yarn	Grains Per Hank	Number of Yarn	Grains Per Hank	Number of Yarn	Grains Per Hank
9	777.78	20	350.00	31	225.81	42	166.67	53	132.08	76	92.1
9¼	756.76	20¼	345.68	31¼	224.00	42¼	165.68	53¼	131.46	77	90.9
9½	736.84	20½	341.46	31½	222.22	42½	164.71	53½	130.84	78	89.7
9¾	717.95	20¾	337.35	31¾	220.47	42¾	163.74	53¾	130.23	79	88.6
10	700.00	21	333.33	32	218.75	43	162.79	54	129.63	80	87.5
10¼	682.93	21¼	329.41	32¼	217.05	43¼	161.85	54¼	129.03	81	86.4
10½	666.67	21½	325.58	32½	215.38	43½	160.92	54½	128.44	82	85.4
10¾	651.16	21¾	321.84	32¾	213.74	43¾	160.00	54¾	127.85	83	83.3
11	636.36	22	318.18	33	212.12	44	159.09	55	127.27	84	84.3
11¼	622.22	22¼	314.61	33¼	210.52	44¼	158.19	55¼	126.70	85	82.4
11½	608.70	22½	311.11	33½	208.96	44½	157.30	55½	126.13	86	81.4
11¾	595.74	22¾	307.69	33¾	207.41	44¾	156.42	55¾	125.56	87	80.5
12	583.33	23	304.35	34	205.88	45	155.56	56	125.00	88	79.5
12¼	571.43	23¼	301.08	34¼	204.38	45¼	154.70	56¼	124.44	89	78.7
12½	560.00	23½	297.87	34½	202.90	45½	153.85	56½	123.89	90	77.8
12¾	549.02	23¾	294.74	34¾	201.44	45¾	153.01	56¾	123.35	91	76.9
13	538.46	24	291.67	35	200.00	46	152.17	57	122.81	92	76.1
13¼	528.30	24¼	288.66	35¼	198.58	46¼	151.35	57¼	122.27	93	75.3
13½	518.52	24½	285.71	35½	197.18	46½	150.54	57½	121.74	94	74.5
13¾	509.09	24¾	282.83	35¾	195.80	46¾	149.73	57¾	121.21	95	73.7
14	500.00	25	280.00	36	194.44	47	148.94	58	120.69	96	72.9
14¼	491.23	25¼	277.23	36¼	193.10	47¼	148.15	58¼	120.17	97	72.2
14½	482.76	25½	274.51	36½	191.78	47½	147.37	58½	119.66	98	71.4
14¾	474.58	25¾	271.84	36¾	190.48	47¾	146.60	58¾	119.15	99	70.7
15	466.67	26	269.23	37	189.19	48	145.83	59	118.64	100	70.0
15¼	459.02	26¼	266.67	37¼	187.92	48¼	145.08	59¼	118.14	105	66.7
15½	451.61	26½	264.15	37½	186.67	48½	144.33	59½	117.64	110	63.6
15¾	444.44	26¾	261.68	37¾	185.43	48¾	143.59	59¾	117.15	115	60.9
16	437.50	27	259.26	38	184.21	49	142.86	60	115.67	120	58.3
16¼	430.77	27¼	256.88	38¼	183.01	49¼	142.13	61	114.8	125	56.0
16½	424.24	27½	254.55	38½	181.82	49½	141.41	62	112.9	130	53.8
16¾	417.91	27¾	252.25	38¾	180.65	49¾	140.70	63	111.1	135	51.9
17	411.76	28	250.00	39	179.49	50	140.00	64	109.4	140	50.0
17¼	405.80	28¼	247.79	39¼	178.35	50¼	139.30	65	107.7	145	48.3
17½	400.00	28½	245.61	39½	177.21	50½	138.61	66	106.1	150	46.7
17¾	394.37	28¾	243.48	39¾	176.10	50¾	137.93	67	104.5	155	45.2
18	388.89	29	241.38	40	175.00	51	137.25	68	102.9	160	43.7
18¼	383.56	29¼	239.32	40¼	173.91	51¼	136.59	69	101.4	165	42.4
18½	378.38	29½	237.29	40½	172.84	51½	135.92	70	100.0	170	41.2
18¾	373.33	29¾	235.29	40¾	171.78	51¾	135.27	71	98.6	175	40.0
19	368.42	30	233.33	41	170.73	52	134.62	72	97.2	180	38.9
19¼	363.64	30¼	231.40	41¼	169.70	52¼	133.97	73	95.9	185	37.8
19½	358.97	30½	229.51	41½	168.67	52½	133.33	74	94.6	190	36.8
19¾	354.43	30¾	227.64	41¾	167.66	52¾	132.70	75	93.3	195	35.9
—	—	—	—	—	—	—	—	—	—	200	35.0

YARN ORGANIZATIONS

		Card		Draw-Frame		Slubber			Intermediate			Fine Frame			Jack Frame			Spinning	
Yarn Number	Lap Oz. Per Yd.	Draft	Sliver Grains	Sliver Grains	Sliver Hank	Doublings	Draft	Hank	Doublings	Draft	Hank	Doublings	Draft	Hank	Doublings	Draft	Hank	Doublings	Draft
6	16	93	75	75	.111	1	3.6	.40	2	5.	1.00	–	–	–	–	–	–	1	6.
8	16	–	75	75	.111	1	4.5	.50	2	5.	1.25		–	–	–	–	–	1	6.4
10	14	94	65	65	.128	1	3.9	.50	2	5.3	1.33	–	–	–	–	–	–	1	7.5
12	14	–	65	65	.128	1	4.7	.60	2	5.3	1.60	–	–	–	–	–	–	1	7.5
–	14	–	65	65	.128	1	3.9	.50	2	4.	1.00	2	5.	2.50	–	–	–	2	9.6
14	14	–	65	65	.128	1	4.7	.60	2	5.3	1.60	–	–	–	–	–	–	1	8.8
–	14	–	65	65	.128	1	3.9	.50	2	4.	1.00	2	5.	2.50	–	–	–	2	11.2
16	14	–	65	65	.128	1	4.7	.60	2	6.	1.80	–	–	–	–	–	–	1	8.8
–	14	–	65	65	.128	1	3.9	.50	2	4.	1.00	2	6.	3.00	–	–	–	2	10.6
18	14	–	65	65	.128	1	3.9	.50	2	4.	1.00	2	5.	2.50	–	–	–	1	7.2
–	14	–	65	65	.128	1	3.9	.50	2	4.	1.00	2	6.	3.00	–	–	–	2	12.0
20	13	95	60	65	.128	1	3.9	.50	2	4.	1.00	2	5.	2.50	–	–	–	1	8.0
–	13	–	60	65	.128	1	3.9	.50	2	5.3	1.33	2	6.	4.00	–	–	–	2	10.0
22	13	–	60	65	.128	1	3.9	.50	2	4.	1.00	2	5.	2.50	–	–	–	1	8.8
–	13	–	60	65	.128	1	3.9	.50	2	5.3	1.33	2	6.	4.00	–	–	–	2	11.0
24	13	–	60	65	.128	1	3.9	.50	2	4.	1.00	2	5.	2.50	–	–	–	1	8.0
–	13	–	60	65	.128	1	3.9	.50	2	5.3	1.33	2	6.	4.00	–	–	–	2	12.0
26	13	–	60	65	.128	1	3.9	.50	2	4.	1.00	2	6.	3.00	–	–	–	1	8.7
–	13	–	60	65	.128	1	4.7	.60	2	5.	1.50	2	6.	4.50	–	–	–	2	11.6
28	12	–	50	60	.139	1	3.6	.50	2	5.3	1.33	2	5.3	3.50	–	–	–	1	8.0
–	12	–	50	60	.139	1	4.7	.65	2	5.5	1.80	2	6.1	5.50	–	–	–	2	10.2
30	12	–	50	60	.139	1	3.6	.50	2	5.3	1.33	2	5.3	3.50	–	–	–	1	8.6
–	12	–	50	60	.139	1	4.7	.65	2	5.5	1.80	2	6.1	5.50	–	–	–	2	10.9
32	12	–	50	60	.139	1	3.6	.50	2	5.3	1.33	2	6.	4.00	–	–	–	1	8.0
–	12	–	50	60	.139	1	4.7	.65	2	5.5	1.80	2	6.1	5.50	–	–	–	2	11.6
34	12	–	50	60	.139	1	3.6	.50	2	5.3	1.33	2	6.	4.00	–	–	–	1	8.5
–	12	–	50	60	.139	1	4.7	.65	2	5.5	1.80	2	6.1	5.50	–	–	–	2	12.4
36	12	–	50	60	.139	1	3.6	.50	2	5.3	1.33	2	6.	4.00	–	–	–	1	9.0
–	12	–	50	60	.139	1	3.6	.50	2	4.	1.00	2	5.	2.50	2	5.2	6.5	2	11.1
38	12	–	50	60	.139	1	3.6	.50	2	5.3	1.33	2	6.	4.00	–	–	–	1	9.5
–	12	–	50	60	.139	1	3.6	.50	2	4.	1.00	2	5.	2.50	2	5.2	6.5	2	11.7
40	12	–	50	60	.139	1	3.6	.50	2	4.	1.00	2	5.	2.50	2	6.4	8.0	2	10.0
50	12	117	45	60	.139	1	3.6	.50	2	4.	1.00	2	6.	3.00	2	6.7	10.	2	10.0
60	12	–	45	60	.139	1	4.3	.60	2	5.	1.50	2	5.3	4.00	2	6.0	12.	2	10.0
70	12	–	45	60	.139	1	4.3	.60	2	5.	1.50	2	6.	4.50	2	6.2	14.	2	10.0
80	12	–	45	60	.139	1	4.7	.65	2	5.5	1.80	2	5.6	5.00	2	6.4	16.	2	10.0
90	12	–	45	60	.139	1	4.7	.65	2	5.5	1.80	2	6.1	5.50	2	6.5	18.	2	10.0
100	12	–	45	60	.139	1	4.7	.65	2	5.5	1.80	2	6.4	5.75	2	7.0	20.	2	10.0
110	11	137	35	50	.167	1	4.8	.80	2	5.5	2.25	2	6.	6.76	2	6.5	22.	2	10.0
120	11	–	35	50	.167	1	4.8	.80	2	5.5	2.25	2	6.	6.75	2	7.1	24.	2	10.0

PURIFICATION OF FEED WATERS

Few, if any, waters are pure as they are taken from their sources, and the losses occasioned by the impurities they contain amount to millions of dollars annually. In washing or scouring processes the soluble salts of lime and magnesia found in many waters destroy the soap used, while in steam-generating apparatus the loss through incrustation, or scale, and corrosion is estimated in millions.

The importance of the softening and purification of boiler feed-water cannot be overestimated, and a brief study of the causes and various remedial methods should prove well worth while.

The formation of boiler scale is due to the action of heat, pressure, and concentration on the impurities in suspension and solution in the feed-water, while corrosion is occasioned by the introduction of acids or their formation by the reaction caused by heat, pressure, and concentration on some of the impurities in the feed-water. Some of the substances which may be in solution in boiler feed-water are merely scale-forming. Others are corrosive, while some break down into both corrosive and scale-forming compounds.

The characteristics of some of the commoner impurities found in many natural waters are as follows: Carbonate of lime, or calcium carbonate, by itself will not form hard scale, but other substances are frequently found present with it which will cause it to cement to the tubes. One of these salts is calcium sulphate, which is responsible for the hardest boiler scale, as it acts as a cement, causing a hard scale formation with many salts which would otherwise form sludge. Calcium chloride, which is extremely soluble, forms a scale only under great concentration, but it should, however, be classed among the corrosive substances, since when concentrated it may become dis-associated, liberating hydrochloric acid. While some authorities hold that magnesium sulphate by itself will not form scale, it is generally classed as a scale-forming substance, especially since it may be broken up by lime or calcium salts, when scale will inevitably be formed. Magnesium sulphate by itself will not form scale, but it may be broken up by lime or calcium salts, when a scale will be formed. Magnesium chloride, another of the corrosive substances, is extremely objectionable, since it not only corrodes but forms scale. When either organic or inorganic iron or when the sulphates of iron and alumina are present, they act in the boiler very much like free sulphuric acid, breaking down under the heat, sulphurous acid being set free, and the iron and alu-

mina precipitating out as scale. The acid thus set free is non-volatile, and therefore the percentage of acid in boiler water is being constantly increased by the quantity introduced with the feed, with the resultant decomposition of the boiler metal directly in proportion to the degree of concentration in the boiler. Free carbonic acid, normally present in all natural waters, is another prolific source of scale corrosion, since it is the acid which holds in solution the carbonates of lime and magnesia. The statement has been made that carbonic acid promotes pitting and corrosion, but research tends to disprove this theory, and the present accepted view is that it does not pit or corrode boilers or boiler-plant equipment.

It must be remembered that the generation of steam is a continuous process, fresh feed-water being supplied to the boiler as the water evaporated leaves it, and that since, theoretically at least, only the volatile impurities pass out with the steam, a continual concentration of non-volatile scale-forming and corrosive substances takes place in the boiler, a condition which if unchecked will eventually destroy the boiler and which at all times impairs the efficiency of the plant to the degree that it is permitted to exist.

Among the deleterious effects from impure feed-water are: Reduced rate of evaporation, caused by the insulating effect of the scale on the heating surfaces; the cost of cleaning the boiler and the expense of repairs necessitated by the overheating to which they are subjected where the heating surfaces are scaled; the loss of efficiency in furnaces and stokers installed for the express purpose of increasing evaporation, which, when the feed-water is impure, proportionately increases the concentration, thus forming a greater deposit of scale and therefore a correspondingly rapid increase in the reduction of the efficiency and life of the boiler; the cost of tube-cleaning machines or boiler compounds; the loss due to investment in spare boilers to take the place of those withdrawn for cleaning or repairing, and the loss due to the reduced efficiency of boiler auxiliaries from lower temperatures of the feed-water, particularly noticeable in feed-water heaters and economizers, thus increasing the fuel consumption.

Of the various troubles caused by impure feed-water, corrosion is at once the most dangerous and often the most difficult to overcome. Many methods and devices are in use, nearly all of them based upon sound mechanical or chemical theories designed to do away with the waste and expense resulting from the operation of boilers with water containing scale-forming and corrosive impurities. The chief criticism of many of them is that they are directed against the effect rather

than the cause, while in a few cases they may, like certain drugs, be said to aggravate the trouble for the sake of a merely temporary relief.

The oldest of the methods and the one in most general use is the removal of scale by purely mechanical means, such as hammers, chisels, etc. Out of this method, feasible only in the return tubular type of boiler, the mechanical tube cleaner was evolved. Among the objections that have been offered to the use of the mechanical tube cleaner in connection with a fire-tube boiler is that it affects the life of the tubes, and that cases have been known where these tubes have been expanded to some extent. There has been little claim of harm in the water-tube boiler, but the objection is made that, in water-tube as in any type of boiler, the removal of scale can only be periodical and therefore the boiler is clean only at intervals. To this must be added the loss of power and money occasioned by the shutting down of the boiler, the expense of actual operation of cleaning and the bringing it to steam again, together with the fact that the rapid cooling and reheating must have its effect on the life of the boiler. Evidence of this is found in the number of crystallized tubes frequently seen in piles near boiler houses.

Another method in quite general use and one usually combined with mechanical cleaning is the use of the so-called boiler compounds, which may be divided into two classes,—those which act chemically, and those which act mechanically. Among what may be termed the mechanical compounds are those containing soft soap, or magnesium silicate, which theoretically gives the surface of the boiler a gelatinous coating, preventing the adherence of the scale-forming material to the shell or tubes. Kerosene and crude oil are also used for the same reason, on the theory that they form an envelope around the particles of scale-forming matter in the feed-water, preventing their adherence to the boiler. The compounds which act chemically generally contain soda in combination with some organic acid. Soda ash, or sodium carbonate, forms the basis of most such compounds, but shavings of oak bark, distillery slops, tea for the tannic acid which it contains, vinegar providing acetic acid, potatoes and corn for the starch which they contain, leather and slippery elm for the gelatinous matter, molasses or sugar for the soluble lime sucrates, are among the substances which have been used in an endeavor to prevent scale or to keep it soft. Admitting purely for the sake of argument, the efficacy of these various compounds, the point previously mentioned—that only the volatile substances in the feed-water pass from the boiler as steam—should again be noted. In other words, all that the most effective boiler

compound can do is to change the precipitate from one which will adhere to the boiler tubes to one which will be carried in suspension in the boiler water, thus raising the density of the water and consequently its boiling point, not only by the accumulation of the non-volatile impurities natural to the feed-water in its raw or unsoftened state, but also by the amount of non-volatile matter introduced in the compound itself. In overcoming corrosion, boiler compounds are as a rule quite effective, since they are usually alkaline and therefore neutralize the acids, but in order to deal effectively with scale it is essential that the compound be adapted in quality and quantity to the water in which it is used. It must therefore be apparent that the use of boiler compounds for the purification of feed-waters is at best somewhat analogous to taking a remedy for indigestion while persisting in the diet that caused the complaint. If we admit that the boiler compound does remove the impurities from the water that cause incrustation and scale, we must also remember that they do this within the boiler itself, and the degree of purification obtained is directly proportional to the impairment of the efficiency of the boiler as a device for making steam.

Another factor that must be taken into consideration in connection with the use of the compounds is the fact that very few boilers make dry steam, or, in other words, that the steam carries mechanically some of the water out of the boiler, from which it follows that the impurities held in suspension or solution will be carried into the steam lines or to the engine. The assertion has been made that much of the "cutting" or scoring noted in the engines in some plants is due to this cause.

The use of feed-water heaters in connection with boiler plants and particularly where the heater manufacturers have increased the size of the heaters furnished for a certain capacity, supplying suitable filters and pans to take up the precipitates, has been a material aid in solving the problem. However, it is by no means a solution, and so far as water purification is concerned an expensive treatment, though the device has proved itself effective in some cases where the scale-forming salts in the water were not present in sufficient quantity to form much precipitate. The argument is that any apparatus whose primary function is to impart heat to water may be used as a scale collector only at the expense of its efficiency as a heat conductor.

The third solution of the water-purification problem is found in what is generally referred to as a "softening and purification" method. Wholly chemical in its theory and application, it brings about the reactions which neutralize the acids and change the soluble salts of lime and magnesia into insoluble precipitates which may be removed by

sedimentation or filtration and purifies the water before it is delivered to the heater or boilers.

This may be accomplished either by a system of filtration through a bed of reagents, as is done in what may be termed the Zeolite processes, or by the introduction of the reagents into the feed-water, the exact quantities being supplied to react with a definite quantity of a specific feed-water and means provided for the thorough mixture of the reagents with the water, ensuring a complete chemical reaction together with suitable means for sedimentation and clarification. This latter method may be divided into two general classes,—the continuous and the intermittent, according to the type of apparatus used. In the intermittent type, measured quantities of water are treated at all times, and the exact quantities of reagents weighed out, with the result that any water may be accurately treated no matter how it varies in quantity or quality. The Zeolite system is a simple filtration process by which the lime and magnesium salts are removed from the feed-water, the effluent being neutral as well as free from impurities and the filter-bed being capable of regeneration by a simple process of washing with brine.

When the mineral content of the water is variable from day to day, the intermittent system, when the amount of the reagents introduced vary with the character and quantity of the mineral content in the water from day to day, would appear to be preferable. When the feed-water has a fairly uniform mineral content, or where the variation of mineral content is not rapid or great, the continuous system may be properly used. Each system has its peculiar field and virtue, and each will give the desired results.

Whichever system is adopted, to obtain the best results, accurate treatment, which requires careful attention, is essential. The cost of this attention is practically negligible, but it must be given regularly, tests must be accurately made, the reagents properly weighed, and the apparatus kept in good condition. No matter how efficient a steam plant may be, or how carefully its performance is recorded and waste guarded against, the most vital factor in its economy is the degree of efficiency attained in the boilers—a condition directly dependent on the comparative purity of the feed-water.

MAXIMUM LIMITS OF HUMIDITY OF THE ATMOSPHERE AT GIVEN TEMPERATURES

Cotton Cloth Factories Act, 1889.

Dry Bulb Readings.	Wet Bulb Readings.	Grains of Moisture per cubic foot of Air.	Percentage of Humidity Saturation = 100.	Dry Bulb Readings.	Wet Bulb Readings.	Grains of Moisture per cubic foot of Air.	Percentage of Humidity Saturation = 100.
35°	33°	1·9	80	68°	66°	6·6	88
36	34	2·0	82	69	67	6·9	88
37	35	2·1	83	70	68	7·1	88
38	36	2·2	83	71	68·5	7·1	85·5
39	37	2·3	84	72	69	7·1	84
40	38	2·4	84	73	70	7·4	84
41	39	2·5	84	74	70·5	7·4	81·5
42	40	2·6	85	75	71·5	7·65	81·5
43	41	2·7	84	76	72	7·7	79
44	42	2·8	84	77	73	8·0	79
45	43	2·9	85	78	73·5	8·0	77
46	44	3·1	86	79	74·5	8·25	77·5
47	45	3·2	86	80	75·5	8·55	77·5
48	46	3·3	86	81	76	8·6	76
49	47	3·4	86	82	76·5	8·65	74
50	48	3·5	86	83	77·5	8·85	74
51	49	3·6	86	84	78	8·9	72
52	50	3·8	86	85	79	9·2	72
53	51	3·9	86	86	80	9·5	72
54	52	4·1	86	87	80·5	9·55	71
55	53	4·2	87	88	81·5	9·9	71
56	54	4·4	87	89	82·5	10·25	71
57	55	4·5	87	90	83	10·3	69
58	56	4·7	87	91	83·5	10·35	68
59	57	4·9	88	92	84·5	10·7	68
60	58	5·1	88	93	85·5	11·0	68
61	59	5·2	88	94	86	11·1	66
62	60	5·4	88	95	87	11·5	66
63	61	5·6	88	96	88	11·8	66
64	62	5·8	88	97	88·5	11·9	65·5
65	63	6·0	88	98	89	12·0	64

BREAKING WEIGHT OF AMERICAN WARP YARNS, PER SKEIN

By George Draper

Weight given in pounds and tenths.

No.	Breaking Weight	No.	Breaking Weight	No.	Breaking Weight	No.	Breaking Weight
1	–	26	66.3	51	36.6	76	25.8
2	–	27	63.6	52	36.1	77	25.5
3	530.0	28	61.3	53	35.5	78	25.3
4	410.0	29	59.2	54	34.9	79	24.9
5	330.0	30	57.3	55	34.4	80	24.6
6	275.0	31	55.6	56	33.8	81	24.3
7	237.6	32	54.0	57	33.4	82	24.0
8	209.0	33	52.6	58	32.8	83	23.7
9	186.5	34	51.2	59	32.3	84	23.4
10	168.7	35	50.0	60	31.7	85	23.2
11	154.1	36	48.7	61	31.3	86	22.8
12	142.0	37	47.6	62	30.8	87	22.6
13	131.5	38	46.5	63	30.4	88	22.4
14	122.8	39	45.5	64	30.0	89	22.2
15	115.1	40	44.6	65	29.6	90	22.0
16	108.4	41	43.8	66	29.2	91	21.7
17	102.5	42	43.0	67	28.8	92	21.5
18	97.3	43	42.2	68	28.5	93	21.3
19	92.6	44	41.4	69	28.2	94	21.2
20	88.3	45	40.7	70	27.8	95	21.0
21	83.8	46	40.0	71	27.4	96	20.7
22	79.7	47	39.3	72	27.1	97	20.5
23	75.9	48	38.6	73	26.8	98	20.4
24	72.4	49	37.9	74	26.5	99	20.2
25	69.2	50	37.3	75	26.2	100	20.0

CALCULATIONS:

840 yards = 1 Hank

$\frac{1}{7}$ of 840 yards = 120 yards 1 Skein.

7000 grains = 1 lb. Avoirdupois.

$\frac{1}{7}$ of 7000 grains = 1000 grains.

$\frac{7000}{840}$ or $\frac{1000}{120} = 8\frac{1}{3}$ which, multiplied by the length in yards, and the product divided by its weight in grains, gives Number of Yarn.

Dividing 7000 by the weight in grains of one hank of 840 yards gives the number of yarn, or, Dividing 1000 by the weight in grains of one skein of 120 yards gives the number of the yarn.

HYDE'S TABLE

Breaking Weight of English Warp Yarns per Skein

Weight given in pounds and tenths.

No. Yarn	Breaking Weight				
	Ordinary	Fair	Good	Extra	Super-Extra
10	115.6	120.5	125.4	130.2	135.2
11	102.2	104.4	106.6	108.9	111.1
12	96.9	99.1	100.3	103.5	105.7
13	91.9	93.9	96.0	98.1	100.2
14	89.7	91.7	93.8	95.9	97.9
15	83.7	85.6	87.5	89.4	91.4
16	81.7	83.5	85.4	87.2	89.1
17	76.9	78.6	80.4	82.1	83.9
18	72.6	74.2	75.9	77.5	79.2
20	67.9	69.4	70.9	72.4	74.0
22	61.7	63.1	64.4	65.9	67.3
24	58.6	59.9	61.2	62.6	63.9
26	54.6	55.8	57.1	58.3	59.6
28	50.2	51.4	52.5	53.6	54.8
30	48.7	49.7	50.8	51.9	53.0
32	45.6	46.4	47.3	48.2	49.1
34	44.4	45.4	46.4	47.4	48.4
36	41.9	42.8	43.7	44.7	45.7
38	39.7	40.6	41.4	42.4	43.3
40	38.9	39.8	40.7	41.6	42.5
42	37.8	38.6	39.5	40.4	41.2
44	35.2	36.2	37.0	37.8	38.6
46	33.8	34.6	35.3	36.1	36.9
48	32.2	32.9	34.6	34.3	35.1
50	32.1	32.8	33.5	34.2	35.0
55	30.5	31.2	31.9	32.6	33.3
60	27.6	28.2	28.9	29.5	30.1
65	25.5	26.1	26.6	27.2	27.8
70	24.4	24.9	25.5	26.1	26.6
75	22.7	23.2	23.7	24.2	24.8
80	22.0	22.5	23.0	23.5	24.0
85	20.2	20.8	21.4	21.0	22.5
90	19.5	19.2	19.9	20.6	21.3
95	18.5	18.9	19.3	19.7	20.2
100	18.2	18.6	19.0	19.4	19.7
110	15.6	16.0	16.3	16.7	17.0
120	15.5	15.8	16.1	16.4	16.8
130	14.2	14.6	14.9	15.2	15.6
140	13.6	13.9	14.2	14.6	14.9
150	12.4	12.7	12.9	13.2	13.6

RING TRAVELLER TABLE

Warp Yarn					Filling Yarn				
Number of Yarn	Revolutions of Spindles	Diameter of Ring	Number of Traveller	Weight of 10 Travellers in grains	Number of Yarn	Revolutions of Spindles	Diameter of Ring	Number of Traveller	Weight of 10 Travellers in grains
4	4950	2″	14	39	4	4000	1½″	16	44
6	5900	–	12	33	6	4800	–	13	36
8	6700	–	9	23	8	5450	–	10	26
10	7250	–	8	20	10	5950	–	8	20
11	7500	–	7	18	11	6150	–	7	18
12	7750	–	6	16	12	6350	–	6	16
13	7950	–	6	16	13	6500	–	5	14
14	8100	–	5	14	14	6700	–	4	13
15	8300	–	4	13	15	6850	–	3	12
16	8450	–	3	12	16	6950	–	2	11
17	8600	–	2	11	17	7100	–	1	10
18	8750	–	1	10	18	7200	–	1–0	9
19	8850	–	1–0	9	19	7300	–	3–0	8
20	8900	–	2–0	8½	20	7400	–	5–0	7
21	9050	–	3–0	8	21	7500	–	5–0	
22	9100	–	4–0	7½	22	7600	–	6–0	6½
23	9150	–	5–0	7	23	7700	–	6–0	
24	9200	–	6–0	6½	24	7800	–	7–0	6
28	9500	1¾″	7–0	6	28	7900	1⅝″	8–0	5½
32	9500	–	8–0	5½	32	7900	–	9–0	5
34	9600	–	9–0	5	34	7900	–	10–0	4½
36	9700	–	10–0	4½	36	7900	–	11–0	4
38	9800	–	11–0	4	38	7900	–	12–0	3¾
40	9700	1⅝″	12–0	3¾	40	7900	1¼″	13–0	3½
45	9700	1½″	13–0	3½	45	7900	–	14–0	3¼
50	9700	–	14–0	3¼	50	7900	–	15–0	3
55	9600	–	14–0	–	55	7900	–	15–0	
60	9600	–	15–0	3	60	7900	–	16–0	2¾
65	9600	–	15–0	–	65	7800	–	16–0	
70	9500	–	16–0	2¾	70	7800	–	17–0	2½
75	9500	–	16–0	–	75	7800	–	17–0	
80	9300	–	17–0	2½	80	7700	–	18–0	2¼
85	9100	–	17–0	–	85	7600	–	18–0	
90	9100	1⅜″	18–0	2¼	90	7400	–	19–0	2
95	9000	–	19–0	2	95	7400	–	20–0	1¾
100	8700	–	20–0	1¾	100	7200	–	21–0	1½
110	8500	–	21–0	1½	110	6900	–	22–0	1¼

RING SPINNING

To find 100 per cent. Production per Spindle:

$$\frac{\text{Circum. of Front Roll} \times \text{Rev. per M.} \times \text{Minutes} \times \text{Hours}}{36 \text{ inches} \times 840 \times \text{No. of Yarn}} = \text{Lbs. per spindle.}$$

EXAMPLE:

$$\frac{3.1416 \times 90 \times 60 \times 54}{36 \times 840 \times 52} = .582 \text{ Lbs. per spindle.}$$

To find the average number of sides run for 54 hours:

Multiply the Number of Sides by the Number of Hours each has run and divide the total number of hours by 54.

EXAMPLE:

206 sides ran	21 hours	206 x 21	4,326
204 " "	$10\frac{1}{2}$ "	204 x $10\frac{1}{2}$	2,142
200 " "	$10\frac{1}{2}$ "	200 x $10\frac{1}{2}$	2,100
194 " "	16 "	194 x 16	3,104
			11,672

11,672 ÷ 54 = 216 Sides Run for 54 hours.

ROVING FRAMES

To find 100 per cent. Production of Roving Frames from speed of Front Roll:

$$\frac{\text{Circum. of Front Roll} \times \text{Rev. per M.} \times \text{Minutes} \times \text{Hours}}{36 \text{ inches} \times 840} = \text{Hanks per spindle.}$$

EXAMPLE: Assume speed of front roll 80 r. p. m.
" circum. " " 3.927 inches.

$$\frac{3.927 \times 80 \times 60 \times 54}{36 \times 840} = 33.66 \text{ Hanks per spindle.}$$

YARDS OF CLOTH PER LOOM PER HOUR

No allowance for stops.

Picks Per Inch	Picks Per Minute										
	100	105	110	115	120	125	130	135	140	145	150
20	8.33	8.75	9.17	9.58	10.00	10.42	10.83	11.25	11.67	12.08	12.50
22	7.58	7.95	8.33	8.71	9.09	9.47	9.85	10.23	10.61	10.98	11.36
24	6.94	7.29	7.64	7.99	8.33	8.68	9.03	9.37	9.72	10.07	10.42
26	6.41	6.73	7.05	7.37	7.69	8.01	8.33	8.65	8.97	9.29	9.62
28	5.95	6.25	6.55	6.85	7.14	7.44	7.74	8.04	8.33	8.63	8.93
30	5.56	5.83	6.11	6.39	6.67	6.94	7.22	7.50	7.78	8.06	8.33
32	5.21	5.47	5.73	5.99	6.25	6.51	6.77	7.03	7.29	7.55	7.81
34	4.90	5.15	5.39	5.64	5.88	6.13	6.37	6.62	6.86	7.11	7.35
36	4.63	4.86	5.09	5.32	5.56	5.79	6.02	6.25	6.48	6.71	6.94
38	4.39	4.61	4.82	5.04	5.26	5.48	5.70	5.92	6.14	6.36	6.58
40	4.17	4.37	4.58	4.79	5.00	5.21	5.42	5.63	5.83	6.04	6.25
42	3.97	4.17	4.37	4.56	4.76	4.96	5.16	5.36	5.56	5.75	5.95
44	3.79	3.98	4.17	4.36	4.55	4.73	4.92	5.11	5.30	5.49	5.68
46	3.62	3.80	3.99	4.17	4.35	4.53	4.71	4.89	5.07	5.25	5.43
48	3.47	3.65	3.82	3.99	4.17	4.34	4.51	4.69	4.86	5.03	5.21
50	3.33	3.50	3.67	3.83	4.00	4.17	4.33	4.50	4.67	4.83	5.00
52	3.21	3.37	3.53	3.69	3.85	4.01	4.17	4.33	4.49	4.65	4.81
54	3.09	3.24	3.40	3.55	3.70	3.86	4.01	4.17	4.32	4.48	4.63
56	2.08	3.13	3.27	3.42	3.57	3.72	3.87	4.02	4.17	4.32	4.46
58	2.87	3.02	3.16	3.30	3.45	3.59	3.74	3.88	4.02	4.17	4.31
60	2.78	2.92	3.06	3.19	3.33	3.47	3.61	3.75	3.89	4.03	4.17
62	2.69	2.82	2.96	3.09	3.23	3.36	3.49	3.63	3.76	3.90	4.03
64	2.60	2.73	2.86	2.99	3.13	3.26	3.39	3.52	3.65	3.78	3.91
66	2.53	2.65	2.78	2.90	3.03	3.16	3.28	3.41	3.54	3.66	3.79
68	2.45	2.57	2.70	2.82	2.94	3.06	3.19	3.31	3.43	3.55	3.68
70	2.38	2.50	2.62	2.74	2.86	2.98	3.10	3.21	3.33	3.45	3.57
72	2.31	2.43	2.55	2.66	2.78	2.89	3.01	3.13	3.24	3.36	3.47
74	2.25	2.36	2.48	2.59	2.70	2.82	2.93	3.04	3.15	3.27	3.38
76	2.19	2.30	2.41	2.52	2.63	2.74	2.85	2.96	3.07	3.18	3.29
78	2.14	2.24	2.35	2.46	2.56	2.67	2.78	2.88	2.99	3.14	3.21
80	2.08	2.19	2.29	2.40	2.50	2.60	2.71	2.81	2.92	3.02	3.13
82	2.03	2.13	2.24	2.34	2.44	2.54	2.64	2.74	2.85	2.95	3.05
84	1.98	2.08	2.18	2.28	2.38	2.48	2.58	2.68	2.78	2.88	3.98
86	1.94	2.03	2.13	2.23	2.33	2.42	2.52	2.62	2.71	2.81	2.91
88	1.89	1.99	2.08	2.18	2.27	2.37	2.46	2.56	2.65	2.75	2.84
90	1.85	1.94	2.04	2.13	2.22	2.31	2.41	2.50	2.59	2.69	2.78
92	1.81	1.90	1.99	2.08	2.17	2.26	2.36	2.45	2.54	2.63	2.72
94	1.77	1.86	1.95	2.04	2.13	2.22	2.30	2.39	2.48	2.57	2.66
96	1.74	1.82	1.91	2.00	2.08	2.17	2.26	2.34	2.43	2.52	2.60
98	1.70	1.79	1.87	1.96	2.04	2.13	2.21	2.30	2.38	2.47	2.55
100	1.67	1.75	1.83	1.92	2.00	2.08	2.17	2.25	2.33	2.42	2.50

YARDS OF CLOTH PER LOOM PER HOUR

No allowance for stops.

Picks Per Inch	Picks Per Minute										
	155	160	165	170	175	180	185	190	195	200	205
20	12.92	13.33	13.75	14.17	14.58	15.00	15.42	15.83	16.25	16.67	17.08
22	11.74	12.12	12.50	12.88	13.26	13.64	14.02	14.39	14.77	15.15	15.53
24	10.76	11.11	11.46	11.81	12.15	12.50	12.85	13.19	13.54	13.89	14.24
26	9.94	10.26	10.58	10.90	11.22	11.54	11.86	12.18	12.50	12.82	13.14
28	9.23	9.52	9.82	10.12	10.42	10.71	11.01	11.31	11.61	11.90	12.20
30	8.61	8.89	9.17	9.44	9.72	10.00	10.28	10.58	10.83	11.11	11.39
32	8.07	8.33	8.59	8.85	9.11	9.37	9.64	9.90	10.16	10.42	10.68
34	7.60	7.84	8.09	8.33	8.58	8.82	9.07	9.31	9.56	9.80	10.05
36	7.18	7.41	7.64	7.87	8.10	8.33	8.56	8.80	9.03	9.26	9.49
38	6.80	7.02	7.24	7.46	7.68	7.89	8.11	8.33	8.55	8.77	8.99
40	6.46	6.67	6.87	7.08	7.29	7.50	7.71	7.92	8.13	8.33	8.54
42	6.15	6.35	6.55	6.75	6.94	7.14	7.34	7.54	7.74	7.94	8.13
44	5.87	6.06	6.25	6.44	6.63	6.82	7.01	7.20	7.39	7.58	7.77
46	5.62	5.80	5.98	6.16	6.34	6.52	6.70	6.88	7.07	7.25	7.43
48	5.38	5.56	5.73	5.90	6.08	6.25	6.42	6.60	6.77	6.94	7.12
50	5.17	5.33	5.50	5.67	5.83	6.00	6.17	6.33	6.50	6.67	6.83
52	4.97	5.13	5.29	5.45	5.61	5.77	5.93	6.09	6.25	6.41	6.57
54	4.78	4.94	5.09	5.25	5.40	5.56	5.71	5.86	6.02	6.17	6.33
56	4.61	4.76	4.91	5.06	5.21	5.36	5.51	5.65	5.80	5.95	6.10
58	4.45	4.60	4.74	4.88	5.03	5.17	5.32	5.46	5.60	5.75	5.89
60	4.31	4.44	4.58	4.72	4.86	5.00	5.14	5.28	5.42	5.56	5.69
62	4.17	4.30	4.44	4.57	4.70	4.84	4.97	5.11	5.24	5.38	5.51
64	4.04	4.17	4.30	4.43	4.56	4.69	4.82	4.95	5.08	5.21	5.34
66	3.91	4.04	4.17	4.29	4.42	4.55	4.67	4.80	4.92	5.05	5.18
68	3.80	3.92	4.04	4.17	4.29	4.41	4.53	4.66	4.78	4.90	5.02
70	3.69	3.81	3.93	4.05	4.17	4.29	4.40	4.52	4.64	4.76	4.88
72	3.59	3.70	3.82	3.94	4.05	4.17	4.28	4.40	4.51	4.63	4.75
74	3.49	3.60	3.72	3.83	3.94	4.05	4.17	4.28	4.39	4.50	4.62
76	3.40	3.51	3.62	3.73	3.84	3.95	4.06	4.17	4.28	4.29	4.50
78	3.31	3.42	3.53	3.63	3.74	3.85	3.95	4.06	4.17	4.27	4.38
80	3.23	3.33	3.44	3.54	3.65	3.75	3.85	3.96	4.06	4.17	4.27
82	3.15	3.25	3.35	3.46	3.56	3.66	3.76	3.86	3.96	4.07	4.17
84	3.08	3.17	3.27	3.37	3.47	3.57	3.66	3.77	3.87	3.97	4.07
86	3.00	3.10	3.20	3.29	3.39	3.49	3.58	3.68	3.78	3.88	3.97
88	2.94	3.03	3.13	3.22	3.31	3.41	3.50	3.60	3.69	3.79	3.88
90	2.87	2.96	3.06	3.15	3.24	3.33	3.43	3.52	3.61	3.70	3.80
92	2.81	2.90	2.99	3.08	3.17	3.26	3.35	3.44	3.53	3.62	3.71
94	2.75	2.84	2.93	3.01	3.10	3.19	3.28	3.37	3.46	3.55	3.63
96	2.69	2.78	2.86	2.95	3.04	3.13	3.21	3.30	3.39	3.47	3.56
98	2.64	2.72	2.81	2.89	2.98	3.06	3.15	3.23	3.32	3.40	3.49
100	2.58	2.67	2.75	2.83	2.92	3.00	3.08	3.17	3.25	3.33	3.44

YARDS OF CLOTH PER LOOM PER HOUR (cont.)

No allowance for stops.

Picks Per Inch	Picks Per Minute										
	100	105	110	115	120	125	130	135	140	145	150
102	1.63	1.72	1.80	1.88	1.96	2.04	2.12	2.21	2.29	2.37	2.45
104	1.60	1.68	1.76	1.84	1.92	2.00	2.08	2.16	2.24	2.32	2.40
106	1.57	1.65	1.73	1.81	1.89	1.97	2.04	2.12	2.20	2.28	2.36
108	1.54	1.62	1.70	1.77	1.85	1.93	2.01	2.08	2.16	2.24	2.31
110	1.52	1.59	1.67	1.74	1.82	1.89	1.97	2.05	2.12	2.20	2.27
112	1.49	1.56	1.64	1.71	1.79	1.86	1.93	2.01	2.08	2.16	2.23
114	1.46	1.54	1.61	1.68	1.75	1.83	1.90	1.97	2.05	2.12	2.19
116	1.44	1.51	1.58	1.65	1.72	1.80	1.87	1.94	2.01	2.08	2.16
118	1.41	1.48	1.55	1.62	1.69	1 77	1.84	1.91	1.98	2.05	2.12
120	1.39	1.46	1.53	1.60	1.67	1.74	1.81	1.87	1.94	2.01	2.08
122	1.37	1.43	1.50	1.57	1.64	1.71	1.78	1.84	1.91	1.98	2.04
124	1.34	1.41	1.48	1.55	1.61	1.68	1.75	1.81	1.88	1.95	2.01
126	1.32	1.39	1.46	1.52	1.59	1.65	1.72	1.79	1.85	1.92	1.98
128	1.30	1.37	1.43	1.50	1.56	1.63	1.69	1.76	1.82	1.89	1.95
130	1.28	1.35	1.41	1.47	1.54	1.60	1.67	1.73	1.79	1.86	1.92
134	1.24	1.31	1.37	1.43	1.49	1.55	1.62	1.68	1.74	1.80	1.87
136	1.23	1.29	1.35	1.41	1.47	1.53	1.59	1.65	1.72	1.78	1.84
140	1.19	1.25	1.31	1.37	1.43	1.49	1.55	1.61	1.67	1.73	1.79
144	1.16	1.22	1.27	1.33	1.39	1.45	1.50	1.56	1.62	1.68	1.74
146	1.14	1.20	1.26	1.31	1.37	1.43	1.48	1.54	1.60	1.66	1.71
150	1.11	1.17	1.22	1.28	1.33	1.39	1.44	1.50	1.56	1.61	1.67
154	1.08	1.14	1.19	1.24	1.30	1.35	1.41	1.46	1.52	1.57	1.62
156	1.07	1.12	1.18	1.23	1.28	1.34	1.39	1.44	1.50	1.55	1.60
160	1.04	1.09	1.15	1.20	1.25	1.30	1.35	1.41	1.46	1.51	1.56
164	1.02	1.07	1.12	1.17	1.22	1.27	1.32	1.37	1.42	1.47	1.52
166	1.00	1.05	1.10	1.15	1.20	1.26	1.31	1.35	1.41	1.46	1.51
170	.98	1.03	1.08	1 13	1.18	1.23	1.27	1.32	1.37	1.42	1.47
174	.96	1.01	1.05	1.10	1.15	1.20	1.25	1.29	1.34	1.39	1.44
176	.95	.99	1.04	1.09	1.14	1.18	1.23	1.28	1.33	1.37	1.42
180	.93	.97	1.02	1.06	1.11	1.16	1.20	1.25	1.30	1.34	1.39

YARDS OF CLOTH PER LOOM PER HOUR

No allowance for stops.

Picks Per Inch	Picks Per Minute 155	160	165	170	175	180	185	190	195	200	205
102	2.53	2.61	2.70	2.78	2.86	2.94	3.02	3.10	3.19	3.27	3.35
104	2.48	2.56	2.64	2.72	2.80	2.88	2.96	3.04	3.13	3.21	3.29
106	2.44	2.52	2.59	2.67	2.75	2.83	2.91	2.99	3.07	3.14	3.22
108	2.39	2.47	2.55	2.62	2.70	2.78	2.85	2.93	3.01	3.09	3.16
110	2.35	2.42	2.50	2.58	2.65	2.73	2.80	2.88	2.95	3.03	3.11
112	2.31	2.38	2.46	2.53	2.60	2.68	2.75	2.83	2.90	2.98	3.05
114	2.27	2.34	2.41	2.49	2.56	2.63	2.70	2.78	2.85	2.92	3.00
116	2.23	2.30	2.37	2.44	2.51	2.59	2.66	2.73	2.80	2.87	2.95
118	2.19	2.26	2.33	2.40	2.47	2.54	2.61	2.68	2.75	2.82	2.90
120	2.15	2.22	2.29	2.36	2.43	2.50	2.57	2.64	2.71	2.78	2.85
122	2.12	2.19	2.25	2.32	2.39	2.46	2.53	2.60	2.66	2.73	2.80
124	2.08	2.15	2.22	2.28	2.35	2.42	2.49	2.55	2.62	2.69	2.76
126	2.05	2.12	2.18	2.25	2.31	2.38	2.45	2.51	2.58	2.65	2.71
128	2.02	2.08	2.15	2.21	2.28	2.34	2.41	2.47	2.54	2.60	2.67
130	1.99	2.05	2.12	2.18	2.24	2.31	2.37	2.44	2.50	2.56	2.63
134	1.93	1.99	2.05	2.11	2.18	2.24	2.30	2.36	2.43	2.49	2.55
136	1.90	1.96	2.02	2.08	2.14	2.21	2.27	2.33	2.39	2.45	2.51
140	1.85	1.90	1.96	2.02	2.08	2.14	2.20	2.26	2.32	2.38	2.44
144	1.79	1.85	1.91	1.97	2.03	2.08	2.14	2.20	2.26	2.31	2.37
146	1.77	1.83	1.88	1.94	2.00	2.05	2.11	2.17	2.23	2.28	2.34
150	1.72	1.78	1.83	1.89	1.94	2.00	2.06	2.11	2.17	2.22	2.28
154	1.68	1.73	1.79	1.84	1.89	1.95	2.00	2.06	2.11	2.16	2.22
156	1.66	1.71	1.76	1.82	1.87	1.92	1.98	2.03	2.08	2.14	2.19
160	1.61	1.67	1.72	1.77	1.82	1.87	1.93	1.98	2.03	2.08	2.14
164	1.58	1.63	1.68	1.73	1.78	1.83	1.88	1.93	1.98	2.03	2.08
166	1.56	1.61	1.66	1.71	1.76	1.81	1.86	1.91	1.96	2.01	2.06
170	1.52	1.57	1.62	1.67	1.72	1.76	1.81	1.86	1.91	1.96	2.01
174	1.48	1.54	1.58	1.63	1.68	1.72	1.77	1.82	1.87	1.92	1.96
176	1.47	1.52	1.56	1.61	1.66	1.70	1.75	1.80	1.85	1.89	1.94
180	1.44	1.48	1.53	1.57	1.62	1.67	1.71	1.76	1.81	1.85	1.90

Showing the Square Root of the Numbers or Counts, from One to Two Hundred Hanks in the Pound, with the Twist per Inch for Different Kinds of Yarns.

The heavy figures opposite No. 1 show the multipliers for the square root of all numbers throughout the tables.

Counts or Numbers	Square Root	Ordinary Warp Twists	Extra Mule Twist	Mule Twists	Weft Twist	Twist for Doubling	Hosiery Yarn
1	1.00	**4.75**	**4.20**	**3.75**	**3.25**	**2.75**	**2.50**
2	1.41	6.72	5.65	5.30	4.60	3.88	3.53
3	1.73	8.23	6.92	6.49	5.62	4.76	4.33
4	2.00	9.50	8.00	7.50	6.50	5.50	5.00
5	2.23	10.62	8.94	8.37	7.26	6.14	5.59
6	2.44	11.64	9.79	9.18	7.96	6.73	6.12
7	2.64	12.57	10.58	9.92	8.59	7.27	6.61
8	2.82	13.44	11.31	10.50	9.19	7.77	7.07
9	3.00	14.25	12.00	11.25	9.75	8.25	7.50
10	3.16	15.02	12.64	11.85	10.27	8.70	7.90
11	3.31	15.75	13.26	12.43	10.77	9.12	8.29
12	3.46	16.45	13.85	12.99	11.25	9.52	8.66
14	3.74	17.77	14.96	14.03	12.16	10.28	9.35
16	4.00	19.00	16.00	15.00	13.00	11.00	10.00
18	4.24	20.15	16.97	15.90	13.78	11.66	10.60
20	4.47	21.24	17.88	16.77	14.53	12.29	11.18
22	4.69	22.28	18.76	17.58	15.24	12.89	
24	4.89	23.27	19.59	18.37	15.92	13.47	
26	5.09	24.22	20.39	19.11	16.57	14.02	
28	5.29	25.13	21.16	19.84	17.19	14.55	
30	5.47	26.02	21.90	20.53	17.80	15.06	
35	5.91	28.10	23.66	22.18	19.22	16.27	
40	6.32	30.04	15.29	23.71	20.55	17.39	
45	6.70	31.86	26.83	25.15	21.80	18.44	
50	7.07	33.59	28.28	26.51	22.98	19.44	
55	7.41	35.23	29.66	27.81	24.10	20.39	
60	7.74	36.79	30.98	29.04	25.17	21.30	
65	8.06	38.30	32.24	30.23	26.20	22.17	
70	8.36	39.74	33.46	31.37	27.19	23.00	
75	8.66	41.14	34.64	32.47	28.14	23.81	
80	8.94	42.49	35.77	33.54	29.06	24.59	
85	9.21	43.79	36.87	34.57	29.96	25.35	
90	9.48	45.06	37.94	35.47	30.83	26.08	
95	9.74	46.30	38.98	36.55	31.67	26.80	
100	10.00	47.50	40.00	37.50	32.50	27.50	
110	10.48	49.82	41.95	39.33	34.08	28.84	
120	10.95	52.03	43.81	41.07	35.60	30.12	
130	11.40	54.16	45.60	42.75	37.05	31.35	
140	11.83	56.20	47.32	44.37	38.47	32.54	
150	12.24	58.04	48.98	45.92	39.80	33.68	
160	12.64	60.04	50.59	47.43	41.10	34.78	
170	13.03	61.89	52.15	48.89	42.37	35.85	
180	13.41	63.70	53.66	50.31	43.60	36.89	
190	13.78	65.46	55.13	51.69	44.79	37.90	
200	14.14	67.17	56.56	53.03	45.96	38.89	

TO FIGURE CALCULATION WEIGHT OF CHAINS

DRAPER CORPORATION

No. Yarn	Constant	No. Yarn	Constant
1	11.904762	51	.2334
2	5.952	52	.229
3	3.968	53	.2246
4	2.976	54	.2205
5	2.3808	55	.2164
6	1.984	56	.2126
7	1.7006	57	.2089
8	1.488	58	.2053
9	1.3228	59	.2018
10	1.19	60	.1984
11	1.0822	61	.1951
12	.992	62	.192
13	.9158	63	.189
14	.8503	64	.186
15	.7936	65	.1832
16	.744	66	.1804
17	.7003	67	.1777
18	.6614	68	.1751
19	.6265	69	.1725
20	.5952	70	.17
21	.5669	71	.1677
22	.5411	72	.1654
23	.5176	73	.1631
24	.496	74	.1609
25	.4761	75	.1587
26	.4579	76	.1567
27	.4409	77	.1546
28	.4252	78	.1526
29	.4105	79	.1507
30	.3968	80	.1488
31	.384	81	.147
32	.372	82	.1452
33	.3608	83	.1434
34	.3501	84	.1417
35	.34	85	.14
36	.3307	86	.1384
37	.3218	87	.1368
38	.3133	88	.1353
39	.3053	89	.1338
40	.2976	90	.1323
41	.2904	91	.1308
42	.2835	92	.1294
43	.2769	93	.128
44	.2706	94	.1267
45	.2645	95	.1253
46	.2588	96	.124
47	.2533	97	.1227
48	.248	98	.1215
49	.2429	99	.1203
50	.238	100	.119

To Figure Constant—Divide 11.904762 by the No. of yarn equals the constant.

Rule—Point off two places in the ends and yards, or four places in the yards; multiply one by the other and the result by the constant.

Example—Calculation weight of a chain of 400 ends of No. 24 yarn, 5000 yards in length. (24—400—5000 yards.)

50.00	.496—constant for No. 24 yarn.
4.00	200
200.0000	99.200 Lbs. Answer.

Proof—840 × 24 = 20160 yds. to lb. ÷ 400 = 50.4 yds. to lb. of 400 ends.
5000 ÷ 50.4 = 99.2 lbs.

TABLE FOR WARPER PRODUCTION CALCULATION

To find pounds of production multiply the yards warped per minute by the multiplier opposite the number of yarn warped, and the product by the hours of operation times the number of ends. Example: To find the product of a warper running 52 yards per minute, on No. 18 yarn, with 410 ends on beam, for 40 hours (actual running time), 52 x .00397 x 410 x 40 = 3385.6.

Number of Yarn	Multipliers	Number of Yarn	Multipliers	Number of Yarn	Multipliers
6	.01190	27	.00265	48	.00149
7	.01020	28	.00255	49	.00146
8	.00893	29	.00246	50	.00143
9	.00794	30	.00238	52	.00137
10	.00714	31	.00230	54	.00132
11	.00649	32	.00223	56	.00127
12	.00595	33	.00213	58	.00123
13	.00549	34	.00210	60	.00119
14	.00510	35	.00204	62	.00115
15	.00476	36	.00198	64	.00112
16	.00446	37	.00193	66	.00108
17	.00420	38	.00188	68	.00105
18	.00397	39	.00183	70	.00102
19	.00376	40	.00179	75	.00095
20	.00357	41	.00174	80	.00089
21	.00340	42	.00170	85	.00084
22	.00325	43	.00166	90	.00079
23	.00311	44	.00162	95	.00075
24	.00298	45	.00159	100	.00071
25	.00286	46	.00155	–	–
26	.00275	47	.00152	–	–

TABLE SHOWING SPOOLER PRODUCTION

(Whitin Machine Works)

Dimensions of Spools			Revolutions of Spindle per Minute		
Length between Heads	Diameter of Heads	Number of Yarn	750	825	900
Inches	Inches		Pounds per Spindle per Nine Hour Day		
6	5	8	9.7	10.6	11.6
		10	7.7	8.5	9.3
		12	6.5	7.1	7.7
		14	5.6	6.1	6.7
		16	4.9	5.3	5.8
5	4	18	4.3	4.8	5.2
		20	3.9	4.3	4.7
		22	3.5	3.9	4.2
		24	3.2	3.6	3.9
		26	3.0	3.3	3.6
		28	2.8	3.1	3.3
		30	2.6	2.9	3.1
		32	2.4	2.7	3.0
		34	2.3	2.5	2.8
4½	3½	36	2.2	2.4	2.6
		38	2.1	2.3	2.4
		40	2.0	2.2	2.3
		44	1.8	2.0	2.2
		50	1.6	1.7	1.9
3½	3¼	60	1.3	1.4	1.6
		70	1.2	1.3	1.3
		80	1.0	1.1	1.2
3	2¾	90	.9	1.0	1.1
		100	.8	.9	1.0

PRODUCTION TABLE OF RING FILLING YARN[1]

Front roll 1 inch in diameter. Twists per inch 3.25 times the square root of the yarn number, up to No. 26; 3.50 times the square root up to No. 31; above No. 30, 3.75 times the square root.

Number of Yarn	Revolutions of Front Roll per Minute	Revolutions of Spindle per Minute	Hanks Per Spindle per Hour	Pounds per Spindle per Hour	Pounds per Spindle per Week of 54 Hours
4	240	5000	1.00	.248	1339
5	230	5400	1.00	.199	1075
6	220	5600	.99	.166	889
7	214	5800	.99	.140	756
8	208	6000	.98	.122	658
9	202	6200	.97	.108	581
10	196	6400	.96	.096	518
11	190	6500	.95	.086	466
12	184	6600	.94	.078	423
13	180	6700	.94	.072	386
14	176	6800	.93	.066	355
15	172	6900	.92	.061	328
16	168	7000	.91	.057	305
17	166	7100	.90	.053	285
18	162	7200	.88	.049	264
19	158	7200	.87	.046	247
20	156	7300	.86	.043	222
21	154	7300	.85	.040	218
22	152	7400	.84	.038	206
23	150	7400	.83	.036	194
24	148	7600	.82	.034	184
25	146	7600	.81	.032	175
26	144	8000	.80	.031	155
27	142	8200	.79	.029	157
28	140	8200	.78	.028	149
29	138	8300	.76	.026	141
30	136	8300	.76	.025	136
31	134	8900	.75	.024	130
32	132	8800	.74	.023	124
33	130	8900	.73	.022	118
34	128	8900	.72	.021	114
35	126	8900	.71	.020	109
36	124	8900	.70	.019	104
37	122	8800	.69	.018	100
38	120	8800	.68	.018	96
39	118	8800	.67	.017	93
40	116	8800	.67	.017	90
41	114	8700	.66	.016	86
42	112	8700	.64	.015	82
43	110	8600	.63	.015	78
44	108	8600	.62	.014	76
45	106	8500	.61	.014	73
46	104	8500	.60	.013	70
47	104	8500	.60	.013	68
48	102	8400	.59	.012	66
49	102	8300	.59	.012	65
50	100	8200	.58	.012	62
55	96	8200	.55	.010	54
60	92	8000	.53	.009	48
65	88	7700	.51	.008	42
70	84	7400	.49	.007	38
75	82	7500	.48	.006	34
80	80	7400	.46	.006	31
85	78	7400	.46	.005	29
90	76	7400	.44	.005	26
95	74	7400	.44	.005	24
100	72	7400	.43	.004	22

[1] Compiled from Draper's Textile Texts.

PRODUCTION TABLE OF RING WARP YARN

Front roll 1 inch in diameter. Twists per inch 4.75 times the square root of the Yarn number, up to No. 36; 4.50 times the square root up to No. 81; above No. 80, 4.25 times the square root.

No. of Yarn	Revolutions of Front Roll per Minute	Revolutions of Spindle per Minute	Hanks per Spindle per Hour	Pounds per Spindle per Hour	Pounds per Spindle per Week of 54 Hours
4	204	6200	1.05	.263	14.17
5	200	6800	1.04	.208	11.23
6	196	7300	1.03	.172	9.27
7	192	7700	1.02	.146	7.87
8	188	8100	1.01	.128	6.81
9	184	8400	1.00	.111	5.99
10	180	8600	.98	.098	5.29
11	176	8800	.96	.088	4.71
12	172	9000	.94	.079	4.23
13	168	9000	.92	.071	3.82
14	164	9000	.90	.064	3.46
15	160	9300	.88	.059	3.16
16	156	9400	.84	.053	2.90
17	152	9400	.84	.049	2.66
18	148	9400	.82	.046	2.46
19	144	9400	.80	.042	2.27
20	140	9400	.78	.039	2.11
21	138	9400	.77	.037	1.98
22	136	9500	.76	.035	1.86
23	134	9500	.75	.033	1.75
24	132	9600	.74	.031	1.66
25	130	9600	.73	.029	1.57
26	128	9700	.72	.020	1.49
27	126	9700	.71	.026	1.41
28	124	9700	.70	.025	1.35
29	120	9800	.69	.024	1.28
30	120	9800	.68	.023	1.22
31	1[illegible]0	9900	.68	.022	1.18
32	118	10000	.67	.021	1.12
33	118	10100	.67	.020	1.09
34	116	10200	.66	.019	1.04
35	116	10,300	.66	.019	1.02
36	114	10200	.65	.018	.97
37	114	10100	.65	.018	.94
38	112	10000	.64	.017	.91
39	112	10000	.64	.016	.88
40	110	10000	.63	.016	.85
41	110	10000	.63	.015	.83
42	108	10000	.62	.015	.79
43	108	10000	.62	.014	.77
44	106	10000	.61	.014	.75
45	106	10000	.61	.014	.73
46	104	10000	.60	.013	.70
47	104	10000	.60	.013	.68
48	102	10000	.59	.012	.66
49	102	10000	.59	.012	.65
50	100	10000	.58	.012	.63
55	96	10000	.56	.011	.55
60	92	10000	.54	.009	.49
65	88	10000	.52	.008	.43
70	84	10000	.50	.007	.38
75	80	9800	.48	.006	.34
80	78	9600	.47	.006	.31
85	76	9400	.46	.005	.29
90	74	9400	.45	.005	.27
95	72	9400	.44	.005	.24
100	70	9400	.42	.004	.22

Allowances have been made for loss in doffing and for contraction of the yarn due to twist.
Compiled from Draper's Textile Texts.

HYDROSTATICS

HYDROSTATICS treats of the pressure of quiet water and other liquids. The pressure of liquids against any point of any surface upon which they act, whether said surface be curved or plain, is always at right angles to that point. At any given depth, the pressure of the water is equal in every direction; and is in direct proportion to the vertical distance below the surface.

To find the total pressure of quiet water against and perpendicular to any surface whatever, as a dam, the side of a container, or water pipe, whether the surface be vertical, horizontal or inclined at any angle whatever, or whether it be flat or curved, or whether it reach the surface of the water or be entirely below it, multiply the area in square feet of the surface pressed by the vertical depth in feet of its centre of gravity below the surface of the water, and the result by the constant number 62.5. The product will be the required pressure in pounds.

HYDRAULICS treats of the flow or motion of water through pipes, aqueducts, rivers, and other channels; also through orifices or openings of various kinds; of machinery for raising water; as well as that in which water furnishes the moving power.

HEAD of water as applied to the flowage of water through canals, pipes or openings in reservoirs, means the vertical distance from the level surface of the water in the reservoir or source of supply to the centre of gravity of the orifice through which the discharge takes place freely into the air, or the vertical distance from the same surface to the level space of the water in a lower reservoir when the discharge takes place under water. It is immaterial as regards the velocity and quantity of the water discharged, whether the pipe is inclined downward, or horizontal, or inclined upward, provided the head and also the length of pipe remain unchanged.

FRICTION HEAD is that part of the total head which balances or counteracts the resistance which the inner surface of the pipe opposes to the flow of water through it, and in pipes of the same diameter, its amount varies in the same proportion as their length.

VELOCITY HEAD is that part of the total head which remains after deducting the friction head and the heads necessary to balance the resistance caused by bends in the pipe or by accumulations of sediment or other causes.

To find the velocity and quantity of water discharged through a straight, smooth, cylindrical cast iron pipe, whose length is not shorter than four times its diameter; knowing its total head, its length and its diameter, multiply the diameter in feet by the total head in feet; divide the product by the total length of the pipe in feet, plus fifty-four times its diameter in feet; take the square root of the quotient and multiply by the constant number forty-eight. The product will be the required velocity in feet per second.

$$\text{Velocity in feet per second} = 48 \cdot \sqrt{\frac{\text{Diameter in feet} \times \text{Total head in feet}}{\text{Total length in feet} + 54 \text{ diameters in feet}}}$$

To find the discharge of water in cubic feet per second multiply the velocity in feet by the area of a circular transverse section of the pipe in feet.

If the pipe instead of being straight, has easy curves, with radii not less than five diameters of the pipe the discharge will not be materially diminished so long as the total heads, and the total actual lengths of pipes remain the same, and provision is made for the escape of air accumulating at the tops of curves.

To find the total head in feet that must be given to a straight, smooth, cylindrical cast iron pipe not less than four diameters long, to enable it to discharge a given required quantity per second, knowing the diameter in feet; multiply the square of the given discharge in cubic feet per second by the length of the pipe in feet, plus fifty-four times its diameter in feet, and divide the quotient by the fifth power of the diameter in feet, divided by .235.

TABLE FOR WEIR MEASUREMENT

(Pelton Water-Wheel Company)

Giving Cubic Feet of Water per Minute that will Flow over a Weir 1 inch wide and from $\frac{1}{8}$ to $20\frac{7}{8}$ inches deep.

Inches		$\frac{1}{8}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$
0	.00	.01	.05	.09	.14	.19	.26	.32
1	.40	.47	.55	.64	.73	.82	.92	1.02
2	1.13	1.23	1.35	1.46	1.58	1.70	1.82	1.95
3	2.07	2.21	2.34	2.48	2.61	2.76	2.90	3.05
4	3.20	3.35	3.50	3.66	3.81	3.97	4.14	4.30
5	4.47	4.64	4.81	4.98	5.15	5.33	5.51	5.69
6	5.87	6.06	6.25	6.44	6.62	6.82	7.01	7.21
7	7.40	7.60	7.80	8.01	8.21	8.42	8.63	8.83
8	9.05	9.26	9.47	9.69	9.91	10.13	10.35	10.57
9	10.80	11.02	11.25	11.48	11.71	11.94	12.17	12.41
10	12.64	12.88	13.12	13.36	13.60	13.85	14.09	14.34
11	14.59	14.84	15.09	15.34	15.59	15.85	16.11	16.36
12	16.62	16.88	17.15	17.41	17.67	17.94	18.21	18.47
13	18.74	19.01	19.29	19.56	19.84	20.11	20.39	20.67
14	20.95	21.23	21.51	21.80	22.08	22.37	22.65	22.94
15	23.23	23.52	23.82	24.11	24.40	24.70	25.00	25.30
16	25.60	25.90	26.20	26.50	26.80	27.11	27.42	27.72
17	28.03	28.34	28.65	28.07	29.28	29.59	29.91	30.22
18	30.54	30.86	31.18	31.50	31.82	32.15	32.47	32.80
19	33.12	33.45	33.78	34.11	34.44	34.77	35.10	35.44
20	35.77	36.11	36.45	36.78	37.12	37.46	37.80	38.15

EXAMPLE. Suppose the weir to be 60 inches long, and the depth of water on it to be $8\frac{3}{8}$ inches. Follow down the left-hand column of the figures in the table until you come to 8 inches. Then run across the table on a line with the 8 until under $\frac{3}{8}$, on top line, and you will find 9.69. This multiplied by 60, the length of weir, gives 581.40, the number of cubic feet of water passing per minute.

TABLE SHOWING THE PRESSURE OF WATER ON EACH SQUARE FOOT OF SURFACE AT DIFFERENT DEPTHS

Vertical Depth in Feet	Pressure per Square Foot	Vertical Depth in Feet	Pressure per Square Foot	Vertical Depth in Feet	Pressure per Square Foot	Vertical Depth in Feet	Pressure per Square Foot	Vertical Depth in Feet	Pressure per Square Foot
1	62.5	11	687.5	21	1,312.5	31	1,937.5	41	2,562.5
2	125	12	750	22	1,375	32	2,000	42	2,625
3	187.5	13	812.5	23	1,437.5	33	2,062.5	43	2,687.5
4	250	14	875	24	1,500	34	2,125	44	2,750
5	312.5	15	937.5	25	1,562.5	35	2,187.5	45	2,812.5
6	375	16	1,000	26	1,625	36	2,250	46	2,875
7	437.5	17	1,062.5	27	1,687.5	37	2,312.5	47	2,937.5
8	500	18	1,125	28	1,750	38	2,375	48	3,000
9	562.5	19	1,187.5	29	1,812.5	39	2,437.5	49	3,062.5
10	625	20	1,250	30	1,875	40	2,500	50	3,125

PRESSURE IN POUNDS PER SQUARE INCH FOR DIFFERENT HEADS OF WATER

At 62° F. 1 foot head = 0.433 lb. per square inch, .433 × 144 = 62.352 lbs. per square foot.

Head, Feet.	0	1	2	3	4	5	6	7	8	9
0	—	0.433	0.866	1.299	1.732	2.165	2.598	3.031	3.464	3.897
10	4.330	4.763	5.196	5.629	6.062	6.495	6.928	7.361	7.794	8.227
20	8.660	9.093	9.526	9.959	10.392	10.825	11.258	11.691	12.124	12.557
30	12.990	13.423	13.856	14.289	14.722	15.155	15.588	16.021	16.454	16.887
40	17.320	17.753	18.186	18.619	19.052	19.485	19.918	20.351	20.784	21.217
50	21.650	22.083	22.516	22.949	23.382	23.815	24.248	24.681	25.114	25.547
60	25.980	26.413	26.846	27.279	27.712	28.145	28.578	29.011	29.444	29.877
70	30.310	30.743	31.176	31.609	32.042	32.475	32.908	33.341	33.774	34.207
80	34.640	35.073	35.506	35.939	36.372	36.805	37.238	37.671	38.104	38.537
90	38.970	39.403	39.836	40.269	40.702	41.135	41.568	42.001	42.436	42.867

TABLE FOR CALCULATING THE HORSE POWER OF WATER HEADS

(Pelton Water Wheel Company)

The following table gives the horse-power of 1 cubic foot of water per minute under heads from 1 up to 2,100 feet.

Heads in Feet	Horse-power	Heads in Feet.	Horse-power.	Heads in Feet.	Horse-power.	Heads in Feet.	Horse-power.
1	.001	220	.354	430	.692	1,050	1.690
20	.032	230	.370	440	.708	1,100	1.770
30	.048	240	.386	450	.724	1,150	1.851
40	.064	250	.402	460	.740	1,200	1.931
50	.080	260	.418	470	.756	1,250	2.012
60	.096	270	.434	480	.772	1,300	2.092
70	.112	280	.450	490	.788	1,350	2.173
80	.128	290	.466	500	.804	1,400	2.253
90	.144	300	.482	520	.827	1,450	2.334
100	.160	310	.499	540	.869	1,500	2.414
110	.177	320	.515	560	.901	1,550	2.495
120	.103	330	.531	580	.933	1,600	2.575
130	.209	340	.547	600	.965	1,650	2.656
140	.225	350	.563	650	1.046	1,700	2.736
150	.241	360	.579	700	1.126	1,750	2.817
160	.257	370	.505	750	1.207	1,800	2.897
170	.273	380	.611	800	1.287	1,850	2.978
180	.289	390	.627	850	1.368	1,900	3.058
190	.305	400	.643	900	1.448	1,950	3.139
200	.321	410	.660	950	1.529	2,000	3.219
210	.338	420	.670	1,000	1.609	2,100	3.380

CONVERSION OF THERMOMETER READINGS

DEGREES CENTIGRADE TO DEGREES FAHRENHEIT

C	F	C	F	C	F	C	F	C	F	C	F
−40	−40.0	+5	+41.0	+40	+104.0	+175	+347	+350	+662	+750	+1382
−38	−36.4	6	42.8	41	105.8	180	356	355	671	800	1472
−36	−32.8	7	44.6	42	107.6	185	365	360	680	850	1562
−34	−29.2	8	46.4	43	109.4	190	374	365	689	900	1652
−32	−25.6	9	48.2	44	111.2	195	383	370	698	950	1742
−30	−22.0	10	50.0	45	113.0	200	392	375	707	1000	1832
−28	−18.4	11	51.8	46	114.8	205	401	380	716	1050	1922
−26	−14.8	12	53.6	47	116.6	210	410	385	725	1100	2012
−24	−11.2	13	55.4	48	118.4	215	419	390	734	1150	2102
−22	−7.6	14	57.2	49	120.2	220	428	395	743	1200	2192
−20	−4.0	15	59.0	50	122.0	225	437	400	752	1250	2282
−19	−2.2	16	60.8	55	131.0	230	446	405	761	1300	2372
−18	−0.4	17	62.6	60	140.0	235	455	410	770	1350	2462
−17	+1.4	18	64.4	65	149.0	240	464	415	779	1400	2552
−16	3.2	19	66.2	70	158.0	245	473	420	788	1450	2642
−15	5.0	20	68.0	75	167.0	250	482	425	797	1500	2732
−14	6.8	21	69.8	80	176.0	255	491	430	806	1550	2822
−13	8.6	22	71.6	85	185.0	260	500	435	815	1600	2912
−12	10.4	23	73.4	90	194.0	265	509	440	824	1650	3002
−11	12.2	24	75.2	95	203.0	270	518	445	833	1700	3092
−10	14.0	25	77.0	100	212.0	275	527	450	842	1750	3182
−9	15.8	26	78.8	105	221.0	280	536	455	851	1800	3272
−8	17.6	27	80.6	110	230.0	285	545	460	860	1850	3362
−7	19.4	28	82.4	115	239.0	290	554	465	869	1900	3452
−6	21.2	29	84.2	120	248.0	295	563	470	878	1950	3542
−5	23.0	30	86.0	125	257.0	300	572	475	887	2000	3632
−4	24.8	31	87.8	130	266.0	305	581	480	896	2050	3722
−3	26.6	32	89.6	135	275.0	310	590	485	905	2100	3812
−2	28.4	33	91.4	140	284.0	315	599	490	914	2150	3902
−1	30.2	34	93.2	145	293.0	320	608	495	923	2200	3992
0	32.0	35	95.0	150	302.0	325	617	500	932	2250	4082
+1	33.8	36	96.8	155	311.0	330	626	550	1022	2300	4172
2	35.6	37	98.6	160	320.0	335	635	600	1112	2350	4262
3	37.4	38	100.4	165	329.0	340	644	650	1202	2400	4352
4	39.2	39	102.2	170	338.0	345	653	700	1292	2450	4442

Table of values for Interpolation in the above table:

Degrees Centigrade	1	2	3	4	5	6	7	8	9
Degrees Fahrenheit	1.8	3.6	5.4	7.2	9.0	10.8	12.6	14.4	16.2

CONVERSION OF THERMOMETER READINGS

DEGREES FAHRENHEIT TO DEGREES CENTIGRADE

F	C	F	C	F	C	F	C	F	C	F	C
—40	—40.00	+30	—1.11	+80	+26.67	+250	+121.11	+500	+260.00	+900	+482.22
—38	—38.89	31	—0.56	81	27.22	255	123.89	505	262.78	910	487.78
—36	—37.78	32	0.00	82	27.78	260	126.67	510	265.56	920	493.33
—34	—36.67	33	+0.56	83	28.33	265	129.44	515	268.33	930	498.89
—32	—35.56	34	1.11	84	28.89	270	132.22	520	271.11	940	504.44
—30	—34.44	35	1.67	85	29.44	275	135.00	525	273.89	950	510.00
—28	—33.33	36	2.22	86	30.00	280	137.78	530	276.67	960	515.56
—26	—32.22	37	2.78	87	30.56	285	140.55	535	279.44	970	521.11
—24	—31.11	38	3.33	88	31.11	290	143.33	540	282.22	980	526.67
—22	—30.00	39	3.89	89	31.67	295	146.11	545	285.00	990	532.22
—20	—28.89	40	4.44	90	32.22	300	148.89	550	287.78	1000	537.78
—18	—27.78	41	5.00	91	32.78	305	151.67	555	290.55	1050	565.56
—16	—26.67	42	5.56	92	33.33	310	154.44	560	293.33	1100	593.33
—14	—25.56	43	6.11	93	33.89	315	157.22	565	296.11	1150	621.11
—12	—24.44	44	6.67	94	39.44	320	160.00	570	298.89	1200	648.89
—10	—23.33	45	7.22	95	35.00	325	162.78	575	301.67	1250	676.67
— 8	—22.22	46	7.78	96	35.56	330	165.56	580	304.44	1300	704.44
— 6	—21.11	47	8.33	97	36.11	335	168.33	585	307.22	1350	732 22
— 4	—20.00	48	8.89	98	36.67	340	171.11	590	310.00	1400	760.00
— 2	—18.89	49	9.44	99	37 22	345	173.89	595	312.78	1450	787.78
0	—17.78	50	10.00	100	37.78	350	176.67	600	315.56	1500	815.56
+ 1	—17.22	51	10.56	105	40.55	355	179.44	610	321.11	1550	843.33
2	—16.67	52	11.11	110	43.33	360	182.22	620	326.67	1600	871.11
3	—16.11	53	11.67	115	46.11	365	185.00	630	332.22	1650	898.89
4	—15.56	54	12.22	120	48.89	370	187.78	640	337.78	1700	926.67
5	—15.00	55	12.78	125	51.67	375	190.55	650	343.33	1750	954.44
6	—14.44	56	13.33	130	54.44	380	193.33	660	348.89	1800	982.22
7	—13.89	57	13.89	135	57.22	385	196.11	670	354.44	1850	1010.00
8	—13.33	58	14.44	140	60.00	390	198.89	680	360.00	1900	1037.78
9	—12.78	59	15.00	145	62.78	395	201.67	690	365.56	1950	1065.56
10	—12.22	60	15.56	150	65.56	400	204.44	700	371.11	2000	1093.33
11	—11.67	61	16.11	155	68.33	405	207.22	710	376.67	2050	1121.11
12	—11.11	62	16.67	160	71.11	410	210.00	720	382.22	2100	1148.89
13	—10.56	63	17.22	165	73.89	415	212.78	730	387.78	2150	1176.67
14	—10.00	64	17.78	170	76.67	420	215.56	740	393.33	2200	1204.44
15	— 9.44	65	18.33	175	79.44	425	218.33	750	398.89	2250	1232.22
16	— 8.89	66	18.89	180	82.22	430	221.11	760	404.44	2300	1260.00
17	— 8.33	67	19.44	185	85.00	435	223.89	770	410.00	2350	1287.78
18	— 7.78	68	20.00	190	87.78	440	226.67	780	415.56	2400	1315.56
19	— 7.22	69	20.56	195	90.55	445	229.44	790	421.11	2450	1343.33
20	— 6.67	70	21.11	200	93.33	450	232.22	800	426.67	2500	1371.11
21	— 6.11	71	21.67	205	96.11	455	235.00	810	432.22	2550	1398.89
22	— 5.56	72	22.22	210	98.89	460	237.78	820	437.78	2600	1426.67
23	— 5.00	73	22.78	215	101.67	465	240.55	830	443.33	2650	1454.44
24	— 4.44	74	23.33	220	104.44	470	243.33	840	448.89	2700	1482.22
25	— 3.89	75	23.89	225	107.22	475	246.11	850	454.44	2750	1510.00
26	— 3.33	76	24.44	230	110.00	480	248.89	860	460.00	2800	1537.78
27	— 2.78	77	25.00	235	112.78	485	251.67	870	465.56	2850	1565.56
28	— 2.22	78	25.56	240	115.56	490	254.44	880	471.11	2900	1593.33
29	— 1.67	79	26.11	245	118.33	495	257.22	890	476.67	2950	1621.11

Table of values for Interpolation in the above table:

Degrees Fahrenheit	1	2	3	4	5	6	7	8	9
Degrees Centigrade	0.56	1.11	1.67	2.22	2.78	3.33	3.89	4.44	5.00

*All decimals in the table are repeating decimals: 37.78 is really 37.777.

APPROXIMATE POWER REQUIRED FOR COTTON MACHINERY

	H. P.
Self Feeding Openers	3
Combined Self Feeding Opener and Single Beater Breaker Lapper	9
40″ Single Beater Intermediate or Finisher Lapper	$4\frac{1}{2}$
Two-Beater Intermediate or Finisher Lapper	$7\frac{1}{2}$
Waste Picker	3
Thread Extractor with Condenser	$1\frac{1}{2}$
40″ Revolving Flat Card, Production 450 lbs. per week	$\frac{3}{4}$
" " " " " 750 " " "	1
" " " " " 1000 " " "	$1\frac{1}{4}$
Sliver Lap Machine	$\frac{1}{2}$
Ribbon Lap Machine	1
Comber 6-head	$\frac{1}{2}$
" 8-head	$\frac{2}{3}$
Drawing Frames 5 to 6 delvs. per	1
Slubber Frames 40 to 45 spdls. per	1
Intermediate Frames 55 to 60 spdls. per	1
Roving Frames 70 to 85 " "	1
Jack or Fine Roving Frames 100 spdls. per	1
Ring Spinning Frames:	
6000 r. p. m. (Filling) 110 spdls. per	1
7000 r. p. m. " 100 " "	1
8000 r. p. m. (Warp) 90 " "	1
8500 r. p. m. " 80 " "	1
9000 r. p. m. " 70 " "	1
1000 r. p. m. " 60 " "	1
Twisters 30 to 50 spdls. per	1
Cone Winders 65 drums "	1
Spoolers 200 to 300 spdls."	1
Warpers	$\frac{1}{4}$
Ball Warpers	$\frac{1}{2}$
Slasher	2
Looms:	
32″ and 36″	$\frac{1}{4}$
40″ and 48″	$\frac{1}{3}$
80″	$\frac{1}{2}$
92″ to 108″	$\frac{3}{4}$ to 1
Brusher	1
Brusher and Shearer	3
Cloth Folder	$\frac{1}{3}$ to $\frac{1}{2}$

NOTE.—The above figures are only approximate but they give a fair average of the power required to drive the various machines. The speed production and many other conditions affect the power consumed. For Friction of Belting and Shafting add from 18 to 22 per cent.

HORIZONTAL PRESSURE EXERTED BY BITUMINOUS COAL AGAINST VERTICAL RETAINING WALLS PER FOOT OF LENGTH.

(University of Illinois, Engineering Experiment Station.)

	Horizontal Surface		Sloping Surface			Horizontal Surface		Sloping Surface	
Depth in Feet	Total Pressure Pounds	Pressure Pounds Lowest Foot	Total Pressure Pounds	Pressure Pounds Lowest Foot	Depth in Feet	Total Pressure Pounds	Pressure Pounds Lowest Foot	Total Pressure Pounds	Pressure Pounds Lowest Foot
1	6.4	6.4	10	10	26	4,305	325	6,760	510
2	25.0	19.0	40	30	27	4,641	338	7,290	530
3	57.0	32.0	90	50	28	4,993	350	7,840	550
4	102.0	45.0	160	70	29	5,358	363	8,410	570
5	159.0	57.0	250	90	30	5,733	376	9,000	590
6	229.0	70.0	360	110	31	6,122	389	9,610	610
7	312.0	83.0	490	130	32	6,523	401	10,240	630
8	407.0	96.0	640	150	33	6,935	414	10,890	650
9	516.0	108.0	810	170	34	7,362	427	11,560	670
10	637.0	121.0	1,000	190	35	7,778	440	12,250	690
11	770.0	134.0	1,210	210	36	8,253	452	12,960	710
12	917.0	146.0	1,440	230	37	8,754	465	13,690	730
13	1,076.0	159.0	1,690	250	38	9,193	478	14,440	750
14	1,248.0	172.0	1,960	270	39	9,682	490	15,210	770
15	1,433.0	185.0	2,250	290	40	10,192	503	16,000	790
16	1,630.0	197.0	2,560	310	41	10,669	516	16,810	810
17	1,840.0	210.0	2,890	330	42	11,236	529	17,640	830
18	2,063.0	223.0	3,240	350	43	11,797	541	18,490	850
19	2,298.0	236.0	3,610	370	44	12,331	554	19,360	870
20	2,548.0	248.0	4,000	390	45	12,968	567	20,250	890
21	2,809.0	261.0	4,410	410	46	13,478	580	21,160	910
22	3,083.0	274.0	4,840	430	47	14,100	592	22,090	930
23	3,369.0	287.0	5,290	450	48	14,679	605	23,040	950
24	3,669.0	299.0	5,760	470	49	15,275	618	24,010	970
25	3,981.0	312.0	6,250	490	50	15,925	631	25,000	990

NOTE.—Weight of coal is taken as 50 pounds per cubic foot in calculating this table. Angle of repose for sloping surface is taken as 35°.

OIL AND COAL COSTS COMPARED.

One ton (2,000 lb.) of coal is equivalent in practical heating value to 3.34 bbl. of oil at 325 lb. The table below compares the prices of coal and oil for equivalent cost as fuel in a boiler furnace:

Coal, per Ton (2,000 lb.)	325 lb.* Oil, per bbl.	325 lb.† Oil, per bbl.
$8.00	$2.40	$2.64
7.75	2.32	2.57
7.50	2.25	2.48
7.25	2.17	2.39
7.00	2.10	2.31
6.75	2.02	2.22
6.50	1.95	2.15
6.25	1.87	2.06
6.00	1.80	1.98
5.75	1.72	1.89
5.50	1.65	1.82
5.25	1.57	1.73
5.00	1.50	1.65
4.75	1.43	1.57
4.50	1.35	1.49
4.25	1.28	1.41
4.00	1.20	1.32
3.75	1.13	1.24
3.50	1.05	1.16
3.25	.98	1.08
3.00	.90	.99
2.75	.83	.91
2.50	.75	.83
2.25	.68	.75
2.00	.60	.66

* Not allowing for labor saving.

† Assuming 10% of cost of fuel in labor of firing and handling ashes saved by using oil, a conservative estimate for plant of over 300 horsepower. Extract Jour. A. S. M. E.

NOTE.—For a table showing relative values of coal and oil fuel see 1918 edition of Cotton Mill Yearbook, p. 63.

TABLE SHOWING THE EFFECT OF DIFFERENT LIGHTS ON DYES OF VARIOUS COLORS

(S. Brierley, in The Textile Recorder)

Color	Daylight (North Light.)	Gas (Vertical Incandescent.)	Electric (Carbon Filament.)	Electric (Drawn Wire Filament.)	Electric (Arc Lamp with Ground Glass.)
Bleached White.	Normal.	Faint green tinge.	Faint orange tinge.	Faint yellow tinge.	Faint purple tinge.
Range of Steel Greys.	Normal.	Lighter in tone with a faint green tinge.	Lighter in tone with a faint orange tinge.	Lighter in tone with a faint yellow tinge.	Lighter in tone with a faint purple tinge.
Red . . .	Normal.	Much lighter in tone and much redder.	Very much lighter in tone, brighter and inclined to orange.	Very much lighter in tone, brighter and inclined to orange.	Much lighter in tone and redder.
Orange . .	Normal.	Much lighter in tone, brighter and more yellow.	Very much lighter in tone, brighter and more yellow.	Very much lighter in tone, brighter and more yellow.	Much lighter in tone, brighter and more yellow.
Yellow . .	Normal.	Much lighter in tone, brighter and more yellow.	Very much lighter in tone, paler and thinner in hue.	Very much lighter in tone, paler and thinner in hue.	Rather lighter in tone, very similar in hue.
Green . .	Normal.	Lighter in tone and more green in hue.	Very much darker in tone, duller, and of greenish, slate hue.	Much darker in tone, duller, and towards olive in hue.	Darker in tone and more inclined to blue.
Blue . . .	Normal.	Lighter in tone, more green and inclined to greenish blue.	Very much darker in tone and inclined to dark slate.	Very much darker in tone and appears as dark blue slate.	Darker in tone and thinner in colour.
Violet . .	Normal.	Much darker in tone and much redder in hue.	Very much darker in tone and towards red chocolate in hue.	Very much darker in tone, and towards red chocolate in hue.	Darker in tone and reddish purple in hue.
Dark Reddish Brown.	Normal.	Lighter in tone and rather more yellow in hue.	Lighter in tone and much redder in hue.	Lighter in tone and a little redder in hue.	Lighter in tone and rather redder in hue.
Fawn . .	Normal.	A little lighter in tone, and rather thinner in colour.	Little lighter in tone and rather redder in hue.	Little lighter in tone and a little redder in hue.	Lighter in tone and a little redder in hue.
Greenish Blue.	Normal.	Lighter in tone and more green in hue.	Darker in tone and inclined to olive.	Darker in tone and more green in hue.	Darker in tone and more green in hue.
Bluish Green.	Normal.	Lighter in tone and more green in hue.	Much darker in tone and more green in hue.	Much darker in tone and more green in hue.	Much darker in tone and more green in hue.
Blue (on red side).	Normal.	Lighter in tone, thinner in colour, towards slate in hue.	Much darker in tone and towards purple in hue.	Very much darker in tone and towards purple in hue.	Thinner in colour and towards purple in hue.
Dark Blue (on red side).	Normal.	Lighter in tone and towards blue slate in hue.	Very much darker in tone, almost black.	Very much darker in tone and dark slate in hue,	Much darker in tone and redder in hue.
Standard Khaki.	Normal.	A little lighter in tone and more yellow in hue.	Much darker in tone and much redder in hue.	Darker in tone and more red in hue.	Lighter in tone and rather more red in hue.

GOVERNMENT COTTON YARN PRICES IN EFFECT TO OCTOBER 1, 1918

CARDED WARP TWIST YARNS

Count	Single: Not better than Middling Upland Basis	Single: Strict to Good Middling Add 2½ cts. to Basis	Single: Strict to Good Middling Not less than 1 1/16" Not over 1 1/8" Add 6½ cts. to Basis	Ply: Not better than Middling Upland	Ply: Strict to Good Middling	Ply: Staple Cotton Strict to Good Middling Not less than 1 1/16" Not over 1 1/8" Add to single yarn prices for any standard ply:— 5 cts. on 10s ¼ cts. additional per count over 10s
				Add to single yarn prices—2 to 7 ply: 1 ct. counts not over 10s; 1½ cts. counts over 10s—not over 14s; 2 cts. counts over 14s—not over 20s; 2½ cts. counts over 20s—not over 36s		
8s and below	$0.57½	$0.60	–	$0.58½	$0.61	–
10	.58	.60½	–	.59	.61½	–
12	.59	.61½	–	.60½	.63	–
13	.59½	.62	–	.61	.63½	–
14	.60	.62½	–	.61½	.64	–
16	.61½	.64	–	.63½	.66	–
18	.63	.65½	–	.65	.67½	–
20	.64½	.67	–	.66½	.69	–
22	.66½	.69	–	.69	.71½	–
23	.67½	.70	–	.70	.72½	–
24	.68½	.71	–	.71	.73½	–
26	.70½	.73	–	.73	.75½	–
28	.72½	.75	–	.75	.77½	–
30	.74½	.77	–	.77	.79½	–
32	.77½	.80	–	.80	.82½	–
34	.80½	.83	–	.83	.85½	–
35	.82	.84½	–	.84½	.87	–
36	.83½	.86	$0.90	.86	.88½	$1.01½
38	–	–	.92	–	–	1.04
40	–	–	.94	–	–	1.06½
42	–	–	.96	–	–	1.09
44	–	–	.98	–	–	1.11½
46	–	–	1.00	–	–	1.14
48	–	–	1.02	–	–	1.16½
50	–	–	1.04	–	–	1.19

BASIS—8S AND BELOW:

Over 8 and not over 10—rise of ¼ cent per number.

Over 10 and not over 14—rise of ½ cent per number.

Over 14 and not over 20—rise of ¾ cent per number.

Over 20 and not over 30—rise of 1 cent per number.

Over 30 and not over 36—rise of 1½ cent per number.

On yarns of staple cotton in counts 36 to 50 the rise is one cent per number.

FOR TWISTING ABOVE IN COUNTS 8S TO 12S:

In 8 to 12 plies add 1 cent to above prices; in 13 to 60 plies add 1½ cents to above prices.

For Brownell or Haskell-Dawes tube-twisted yarn in counts 8 to 12—add 4 cents to price for single.

The prices named above are for commercial skeins, tubes, cones, and section beams, of standard put-up.

EXTRAS:

For ball or chain warps one cent per pound extra will be added.

For reverse twist five cents per pound advance over regular twist will be added.

For cabling up to No. 30 a charge of 6½ cents per pound will be added to the price of single yarn.

TERMS:

Prices include the weight of cones or tubes on which yarn is wound and are net cash from date of shipment, and are F. O. B. cars shipping point. Prices include cost of selling.

GOVERNMENT COTTON YARN PRICES IN EFFECT TO OCTOBER 1, 1918

CARDED HOSIERY AND KNITTING YARNS

Count	Single: Standard White Cotton	Single: Staple Cotton Strict to Good Middling Not less than $1\frac{1}{16}''$ Not over $1\frac{1}{8}''$	Ply: Standard White Cotton	Ply: Staple Cotton Strict to Good Middling Not less than $1\frac{1}{16}''$ Not over $1\frac{1}{8}''$
10s and below	$0.61	$0.65	$0.66	$0.70
12	.62	.66	.67½	.71½
14	.63	.67	.69	.73
16	.64½	.68½	.71	.75
18	.66	.70	.73	.77
20	.67½	.71½	.75	.79
22	.69½	.73½	.77½	.81½
24	.71½	.75½	.80	.84
26	.73½	.77½	.82½	.86½
28	.75½	.79½	.85	.89
30	.77½	.81½	.87½	.91½
32	–	.83½	–	.94
34	–	.85½	–	.96½
36	–	.87½	–	.99
38	–	.89½	–	1.01½
40	–	.91½	–	1.04

BASIS—10S AND BELOW:

Over 10 and not over 14—rise of ½ cent per number.
Over 14 and not over 20—rise of ¾ cent per number.
Over 20 and over 40—rise of 1 cent per number.

ADD TO SINGLE YARN PRICES:

5 cts. to 10s.
¼ cent additional per count up to 40s.

FORM OF DELIVERY:

On commercial tubes, cones, cops, or skeins, in standard put-up.

TERMS:

F. O. B. cars shipping point, net cash from date of shipment, 2 per cent. allowance to be made for cones. Prices include cost of selling.

GOVERNMENT COTTON YARN PRICES IN EFFECT TO OCTOBER 1, 1918

COMBED—WARP, HOSIERY AND KNITTING YARNS

Count	Single				Ply			
	Strict to Good Middling Cotton				Strict to Good Middling Cotton			
	Not over $1\frac{1}{16}''$	Over $1\frac{1}{16}''$ and not above $1\frac{1}{8}''$ Add 5 cts. to $1\frac{1}{16}''$ prices	Over $1\frac{1}{8}''$ and not above $1\frac{3}{16}''$ to $1\frac{1}{4}''$ Add 5 cts. to $1\frac{1}{8}''$ prices	Over $1\frac{1}{4}''$ and not above $1\frac{5}{16}''$ to $1\frac{3}{8}''$ Add 10 cts. to $1\frac{1}{4}''$ prices	Not over $1\frac{1}{16}''$	Over $1\frac{1}{16}''$ and not above $1\frac{1}{8}''$ Add 5 cts. to $1\frac{1}{16}''$ prices	Over $1\frac{1}{8}''$ and not above $1\frac{3}{16}''$ to $1\frac{1}{4}''$ Add 5 cts. to $1\frac{1}{8}''$ prices	Over $1\frac{1}{4}''$ and not above $1\frac{5}{16}''$ to $1\frac{3}{8}''$ Add 10 cts to $1\frac{1}{4}''$ prices
10s and below	$0.76	$0.81	$0.86	$0.96	$0.81	$0.86	$0.91	$1.01
12	.77	.82	.87	.97	.82½	.87½	.92½	1.02½
14	.78	.83	.88	.98	.84	.89	.94	1.04
16	.79½	.84½	.89½	.99½	.86	.91	.96	1.06
18	.81	.86	.91	1.01	.88	.93	.98	1.08
20	.82½	.87½	.92½	1.02½	.90	.95	1.00	1.10
22	.84	.89	.94	1.04	.92	.97	1.02	1.12
24	.85½	.90½	.95½	1.05½	.94	.99	1.04	1.14
26	.87½	.92½	.97½	1.07½	.96½	1.01½	1.06½	1.16½
28	.89½	.94½	.99½	1.09½	.99	1.04	1.09	1.19
30	.91½	.96½	1.01½	1.11½	1.01½	1.06½	1.11½	1.21½
36	—	1.02½	1.07½	1.17½	—	1.14	1.19½	1.29
40	—	1.06½	1.11½	1.21½	—	1.19	1.24	1.34
45	—	—	1.16½	1.26½	—	1.25½	1.30½	1.40¼
50	—	—	1.21½	1.31½	—	1.31½	1.36½	1.46½
55	—	—	1.26½	1.36½	—	—	1.42¾	1.52¾
60	—	—	1.31½	1.41½	—	—	1.49	1.59
70	—	—	—	1.56½	—	—	—	1.76½
80	—	—	—	1.71½	—	—	—	1.94

BASIS—10s and below:

Over 10 and not over 14—rise of ½ cent per number.

Over 14 and not over 24—rise of ¾ cent per number.

Over 24 and not over 60—rise of 1 cent per number.

Over 60 and not over 80—rise of 1½ cent per number.

FORMS OF DELIVERY:

Hosiery and knitting yarns on commercial tubes, cops, cones, or skeins, in standard commercial put-ups, suitable for the hosiery, underwear, and regular knitting manufacturers.

Warp yarns on commercial tubes, cones, skeins, section beams, or warps.

EXTRAS:

Such yarns if made of higher twist than standard warp twist, or if put up in other than standard forms for delivery, or if specially made for special work, or specially inspected for removal of imperfections, shall be subject to such additional prices to cover additional costs, as may be agreed upon between the buyer and seller.

Add 5 cents to No. 10 single price and ¼ cent additional per number to single yarn prices on counts to 80s.

TERMS:

All figures are based on prices net cash from date of shipment, F. O. B. cars shipping point for yarns delivered at net weight, such prices to include the cost of selling.

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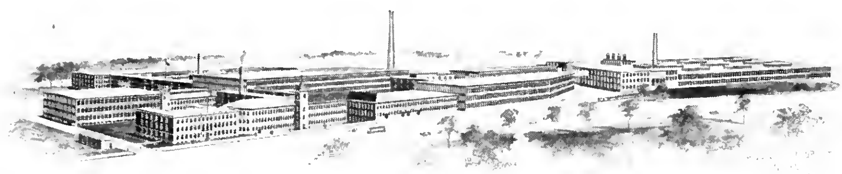

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Picking	Combers	Spoolers	Looms

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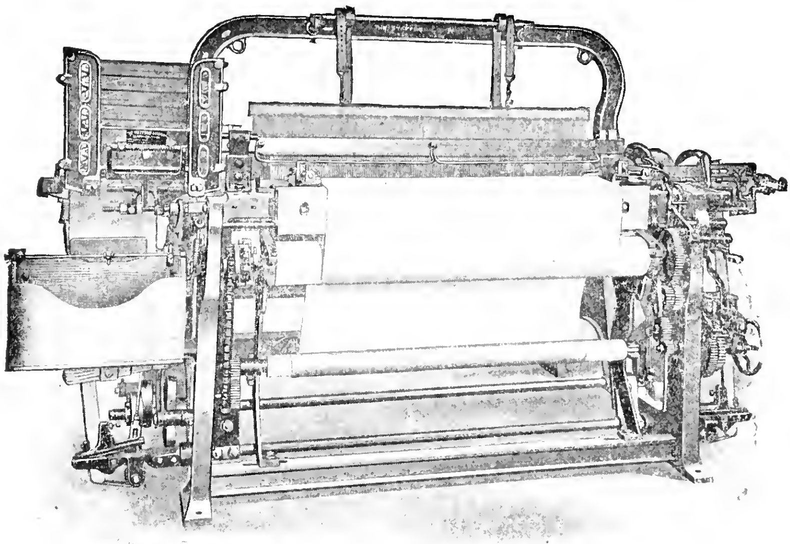

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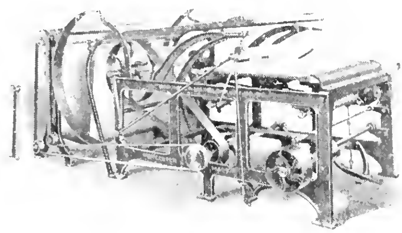

NEW STYLE CLOTH FOLDER
With Drop Table

Fig. 1

Fig. 2
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Sewing
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Spreading
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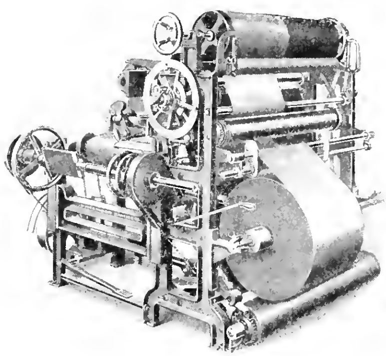

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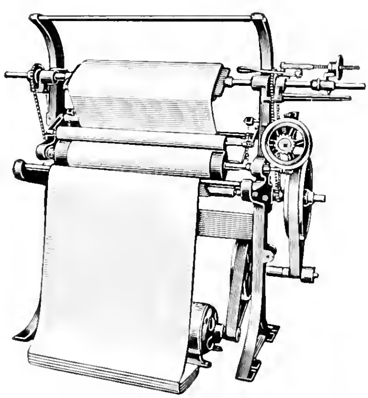

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The Lancashire does the same as the Model E in the open width without doubling

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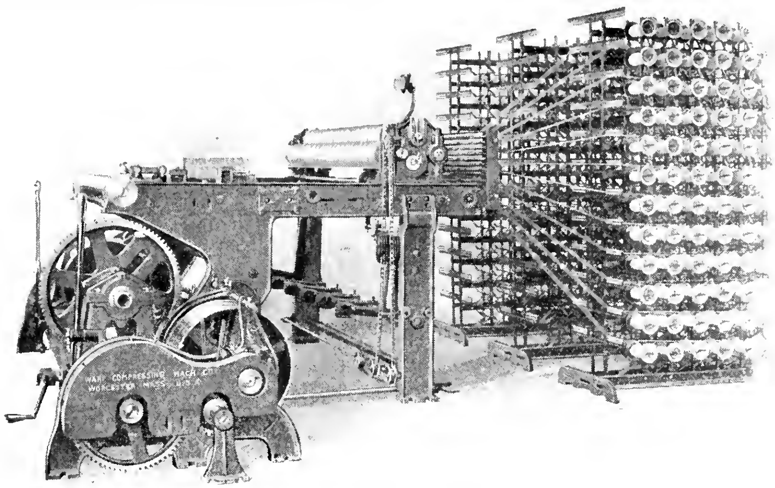

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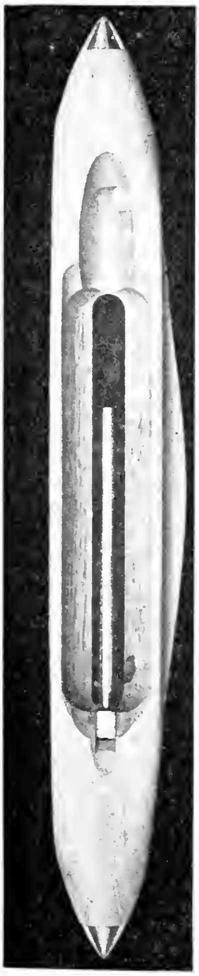

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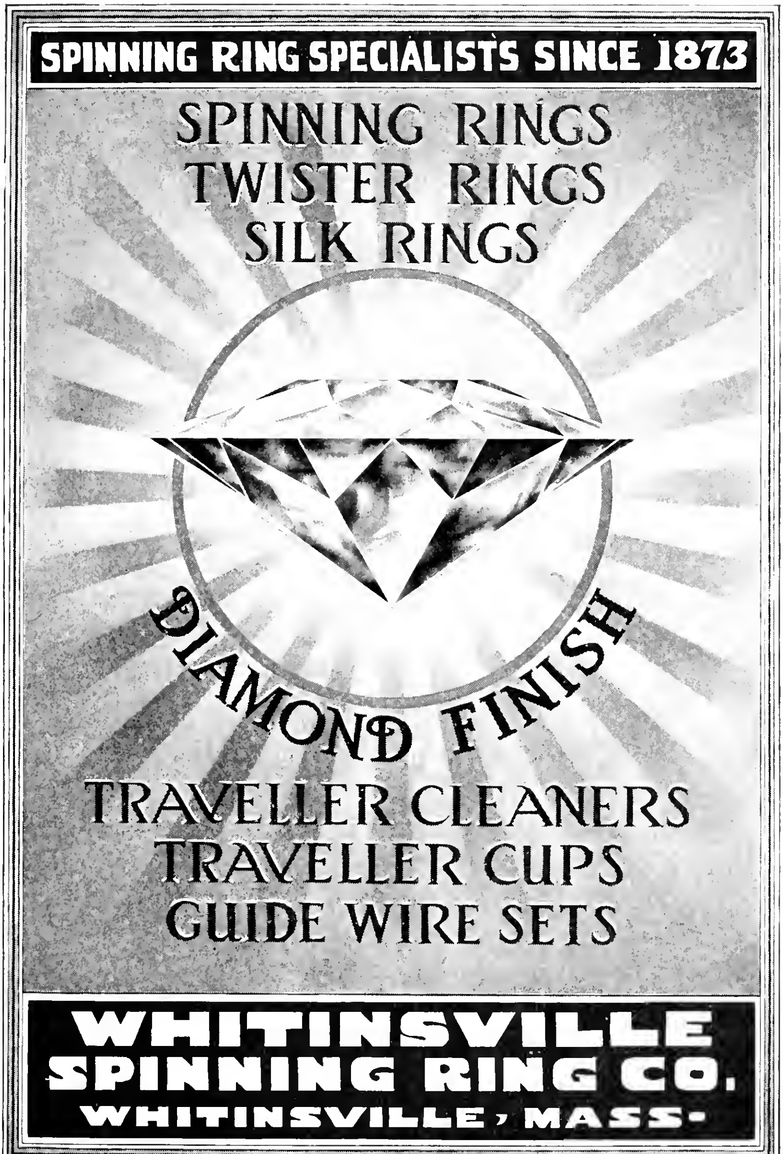

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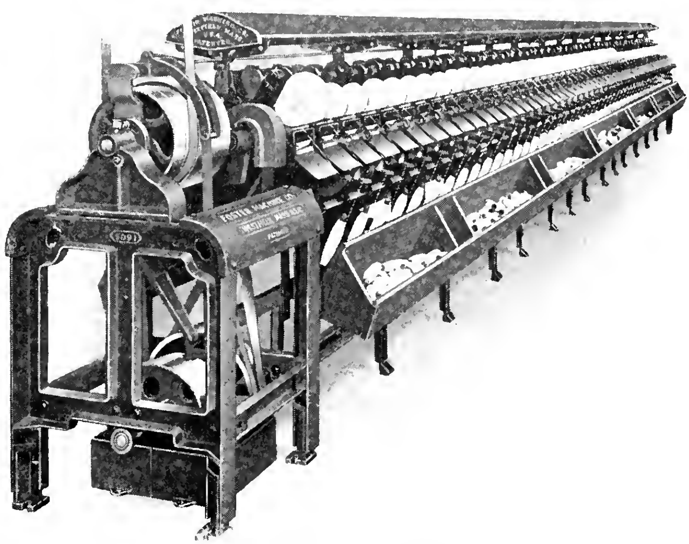

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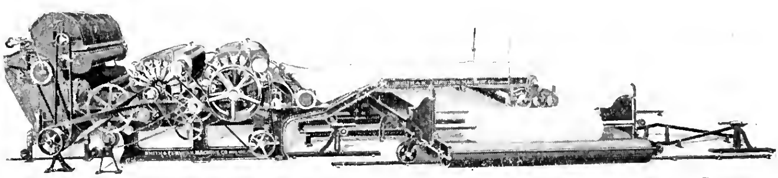

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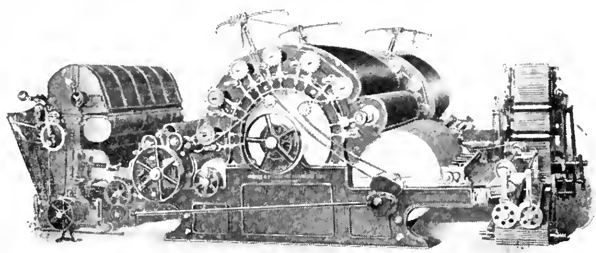

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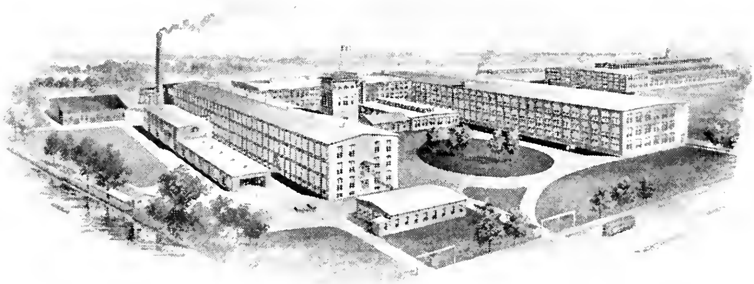

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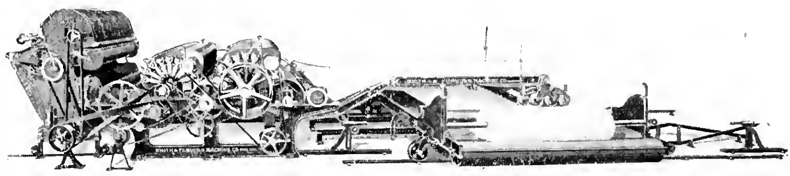

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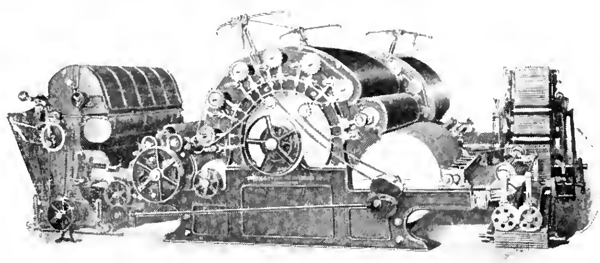
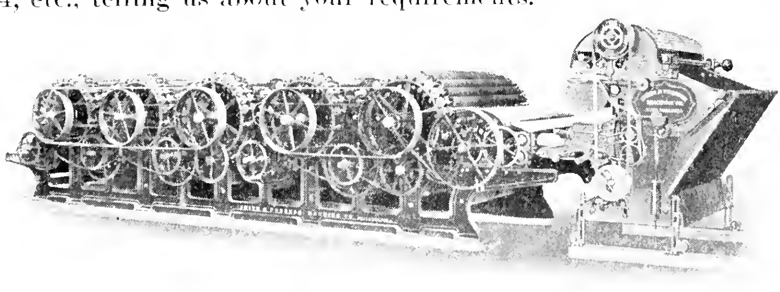


SET OF CARDS FOR COTTON WASTE YARNS

We make cards for all kinds of stocks. Ask for circulars NA 139, 154, etc., telling us about your requirements.



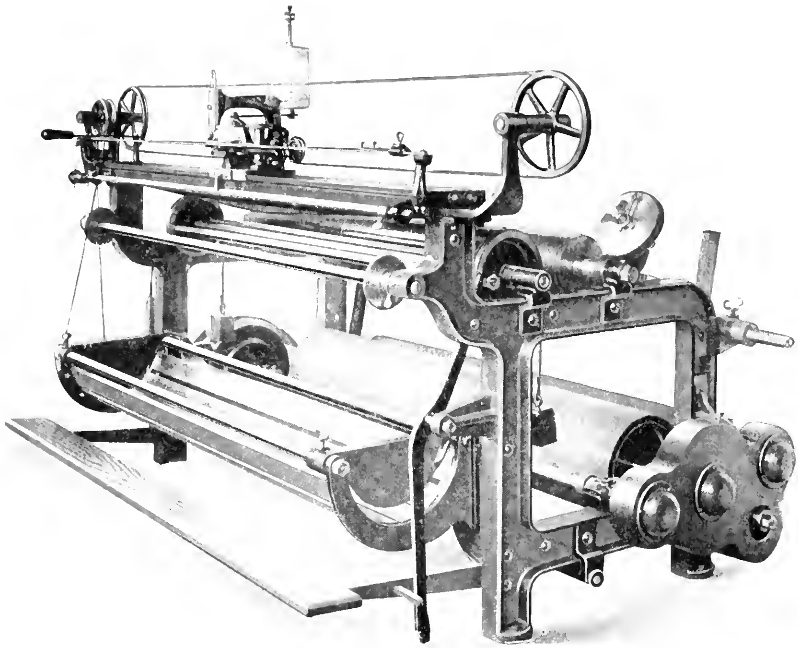
5-CYLINDER GARNETT MACHINE

We specialize on shoddy machinery. Catalogs NM 85, 152, etc.

DINSMORE MANUFACTURING CO.

SALEM, MASS.

SEWING MACHINES



No. 4 Opening, Sewing, and Re-rolling Railway Machine, showing Measuring Roll Dinsmore or Singer Type Head as preferred

RAILWAY AND ROTARY MILL SEWING MACHINES

An absolutely perfect system for joining the ends of cloth to make a continuous piece for all of the various methods of finishing. Thirteen styles.

Send for *Illustrated Catalogue.*

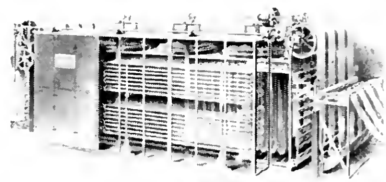
THE PHILADELPHIA TEXTILE MACHINERY COMPANY

BUILDERS OF DRYING MACHINERY

SEVENTH STREET AND TABOR ROAD, PHILADELPHIA, PA.

CHICAGO, ILL. HEARST BUILDING	CHARLOTTE, N.C. REALTY BUILDING	PROVIDENCE, R.I. HOWARD BUILDING

For Every Kind of Drying Need— For Every Class of Textile Mill



Proctor Automatic Loop Dryer for Turkish Toweling, Knit Goods in the String, etc.

"Proctor" DRYERS

4000 IN OPERATION – PROCTOR DRYERS

for

Cotton
Wool
Worsted
Silk
Yarn
Toweling
Hosiery
Underwear
Rags
Tape
etc., etc.

The choice of a dryer always narrows down to a PROCTOR.

All-metal, substantial, fireproof construction—

Compact — Dependable — Efficient — Space- and Labor-saving—

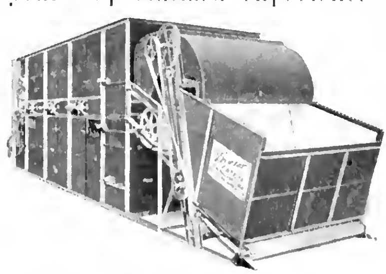
Made for drying any quantity uniformly regardless of the weather.

IN Proctor Dryers the same warm moist air is constantly recirculated, resulting in a saving in the fuel bill. The bearings and fans are designed for minimum friction,—a saving in power costs. Proctor Dryers operate equally well on exhaust or live steam. The Stock Dryer saves one-third of the floor space; the Shrinking Machine eliminates 75% of the man power, etc.

SOLD WITH AN ABSOLUTE GUARANTEE

and backed by 35 years' specialized experience in building dryers.

Proctor Automatic Yarn Dryer for Cotton, Wool, Worsted or Silk Yarns.



Proctor Stock Dryer for Cotton, Wool, Rags, etc.

TOLHURST MACHINE WORKS

Established 1852

Main Office and Works
TROY, N.Y.

New York Office
111 Broadway

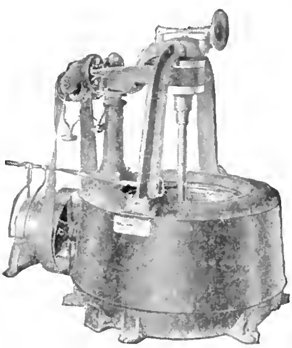
HYDRO-EXTRACTORS

Represented by

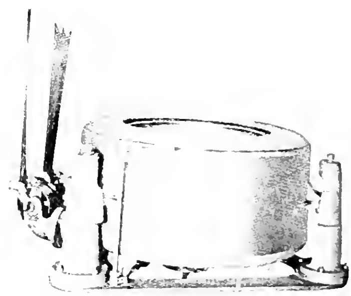
John S. Gage
Hartford Bldg.
Chicago, Ill.

W. J. Westaway
Sun Life Bldg.
Hamilton, Ont.

Fred White
Realty Bldg.
Charlotte, N.C.



"SELF-BALANCING"



"CENTER SLUNG" OPEN TOP

TOLHURST

EXTRACTORS

STANDARD EQUIPMENT
IN
PROGRESSIVE AND EFFICIENT
TEXTILE MILLS

EXTRACTORS FOR Dyeing, Bleaching and Carbonizing
in stock or in piece goods.

Baskets, 26″–72″ diameter.

Countershaft, Engine or Motor Drive.

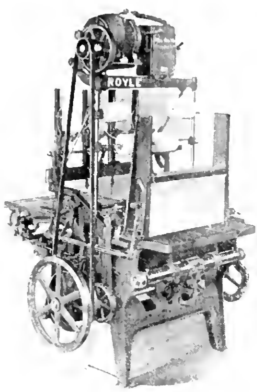
Special Catalog.

JOHN ROYLE & SONS

PATERSON, N.J.

PIANO CARD CUTTERS, LACERS, REPEATERS

ROYLE CARD CUTTERS

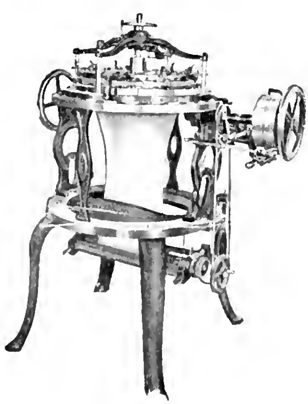


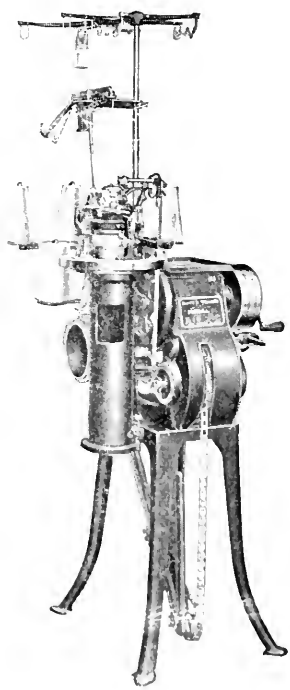
Cut an entire row crosswise at each stroke. The cutter head is of special form, giving complete control of all keys without wearying strain. The skipper motion registers accurately at the highest speed. Speed limited only by operator's expertness.

THE ROYLE LACERS. Automatic in all essential movements, eliminating expensive labor. Well equipped with timing adjustments for accurately relating all mechanical movements to one another. Of the highest capacity,—upwards of 1,800 cards per hour.

THE ROYLE REPEATERS. The essentials are, cutting an entire card at each stroke, and a vertical direction of stroke which utilizes complete power without lateral waste or strain. Repeat the 1304 hook Fine Scale Card as accurately and cleanly as the small 200 hook French Index Card.

Catalog and individual circulars of interest to all manufacturers of figured weaves.





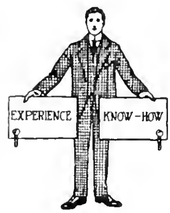
H. W. BUTTERWORTH & SONS CO.

ESTABLISHED 1820

PHILADELPHIA

PROVIDENCE OFFICE
TURK'S HEAD BUILDING

Canadian Representative
W. J. WESTAWAY COMPANY
HAMILTON, ONTARIO, CANADA



THIS is an age of specialization. We are in strict accord with the age because we specialize exclusively on manufacturing finishing machinery and have been doing so for nearly the last one hundred years.

Therefore, we are able to meet modern standards of workmanship and service.

We would be glad to consult with you in regard to installation or replacement of finishing machinery.

FINISHING
Butterworth
MACHINERY

THE J. B. FORD COMPANY

WYANDOTTE, MICH.

CHEMICALS

Have We Made Good

The knowledge of the comparative efficiency of alkalies when used for textile purposes is merely the checking up of results obtained.

Whatever preconceived ideas one may have or conclusions he may have reached by any other reasoning are valuable only in so far as they agree with the results obtained under actual working conditions in the mill.

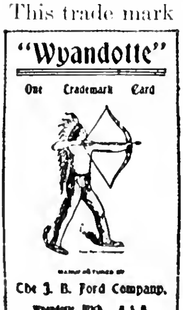
The large and constantly growing demand for

WYANDOTTE TEXTILE SODA
WYANDOTTE CONCENTRATED ASH
WYANDOTTE KIER BOILING SPECIAL

is the proof we give in our answer that *we have made good*—that we have lived up to all our promises—that we have and are continuing to maintain the same high standards of quality and uniformity which pleases and satisfies the users of these products in all parts of our own land and Canada among all classes of the Textile trade.

The preference given to Wyandotte Kier Boiling Special for all kier boiling purposes, also to Wyandotte Concentrated Ash for replacing soda ash in sulphur dyeing or other soda ash uses and Wyandotte Textile Soda in the after treatment on sulphur dyes, as well as for Direct Colors, and in the Hypochlorite bleach this is the proof of efficiency we submit to you.

This trade mark



in every package.

The man who pays the bills and enjoys the profits from the use of these products is not supposed to be prejudiced beyond what the real facts show.

Order from your supply house, or write us for further particulars.

The J. B. Ford Co., Wyandotte, Mich.
Sole Manufacturers

THE J. R. MONTGOMERY COMPANY

WINDSOR LOCKS, CONN.

Manufacturers of

COTTON WARPS—

In Combed and Carded Yarns made from Peeler, Egyptian and Sea Island Cotton, dyed in all colors, put up on beams, plain or in pattern warps, in chain warps or ball warps, skeins, tubes and cones.

MERCERIZED COTTON YARNS—

In gassed or ungassed, plain or colors, on jack spools, tubes, cones, skeins, chain or ball warps.

NOVELTY YARNS—

Bourette, Boucle and Flake Yarns in Silk, Worsted, Cotton or combinations of same.

EMBROIDERY, HAND KNITTING and MENDING COTTON—

Mercerized or unmercerized, in skeins, balls, boxes and labeled.

TINSEL—

Gold, Silver, Copper, on spools, plain or Matt.

TINSEL THREADS—

Gold, Silver, Copper, Antique, Steel.

TINSEL METAL CORDS—

For tying candy boxes and Christmas packages.

TINSEL BRILLIANTS—

In all colors and combinations, two or three ply.

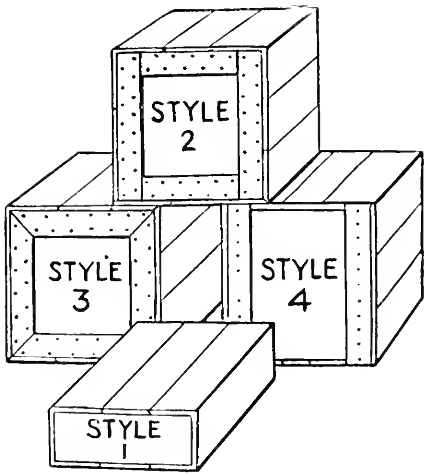
CHAFFEE BROTHERS COMPANY

OXFORD, MASS.

BOXES, CLOTH BOARDS

ESTABLISHED 1883 INCORPORATED 1900

CARLOAD LOTS



A SPECIALTY

23 YEARS MANUFACTURING

CLOTH BOARDS

OF THREE KINDS

PATENT, WOOD, PAPER

SAMPLES AND PRICES FURNISHED UPON REQUEST

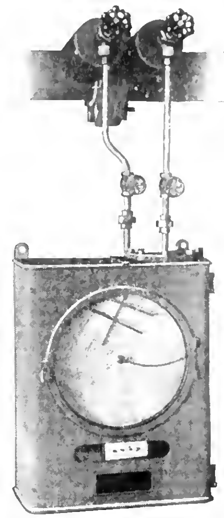
BAILEY METER CO.

BOSTON, MASS.

RECORDING AND INTEGRATING METERS FOR ALL FLUIDS

Bailey Meters are indispensable for:

1. Obtaining maximum capacity and best efficiency in the boiler plant.
2. Accurately measuring the steam distribution to various departments so they can be charged with what they actually use.
3. Checking waste of steam, water, compressed air and other fluids throughout the mill.



Bailey Fluid Meter
Type C2 Class 2

BAILEY FLUID METERS

accurately measure hot boiler feed; hot or cold water supply; high pressure, superheated, low pressure and exhaust steam to turbines, heating systems, dye houses, kiers, dryers, etc.; caustic liquor, compressed air and practically any other fluid used in the textile industry. This meter gives permanent twenty-four hour record showing every change in rate of flow, also gives total directly in pounds, gallons or cubic feet and may record temperature and pressure on the same chart.

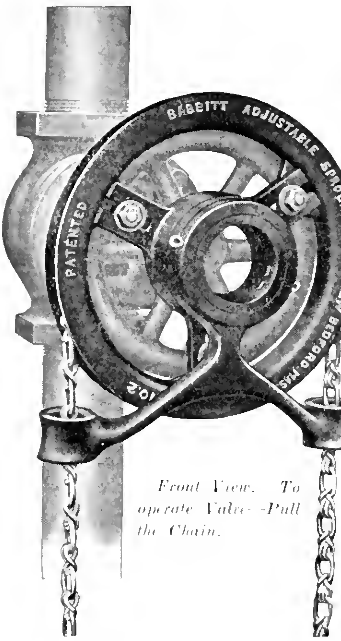
BAILEY BOILER METERS

record the Rate of Steam Output from each boiler and the Rate of Air Flow, showing whether it is more or less than that required for best efficiency. The same meter may also record Flue Gas Temperature, Draft and other factors. The fireman can actually see results being obtained from each boiler and know what is necessary to improve them. A permanent record shows the manager how well each fireman has done his work.

BAILEY METERS SAVE COAL

BABBITT STEAM SPECIALTY CO.

NEW BEDFORD, MASS., U.S.A.



Front View. To operate Valve—Pull the Chain.

Babbitt —*Adjustable*— SPROCKET RIM *with Chain Guide*

Simplifies piping arrangements.

Reduces danger and expense.

Makes overhead and out-of-the-way valves convenient and easy to operate from the floor.

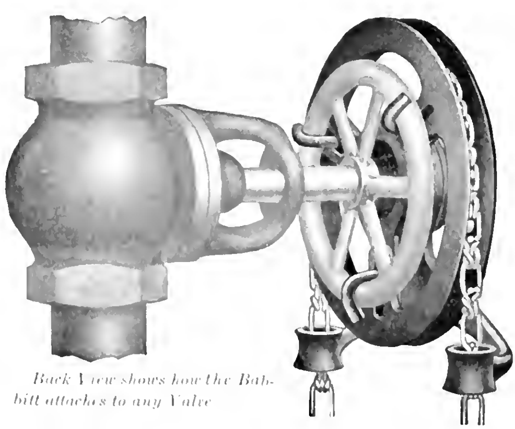
Fits any valve.

Easy to operate; you simply pull a chain—that's all.

Simplest, least expensive device of its kind on the market.

PRICE LIST
AND DIMENSION SHEET

Size No.	Diameter of Sprocket Wheel in Inches	Diameter of Valve Wheels Rim Will Fit	List Price of Rim and Guide Combined	Rust-proof Chain per foot
0	4	2 to 3¾	$2.40	$0.08
1	5⅞	4 " 5¾	4.00	.10
1½	7½	5¾ " 7¾	5.20	.10
2	9	7½ " 8¾	6.40	.10
2½	12½	9 " 12¼	8.80	.16
3	15½	12½ " 15¼	10.80	.16
3½	19	15½ " 18¾	15.20	.16
4	22	19 " 21¾	20.00	.24
4½	26	22 " 25¾	28.00	.24
5	30	26 " 30	32.00	.24



Back View shows how the Babbitt attaches to any Valve

SWAN AND FINCH COMPANY

NEW YORK

HARTFORD PHILADELPHIA CHICAGO PROVIDENCE

DISTRIBUTORS:

ATLANTA: FULTON SUPPLY COMPANY
CHARLOTTE: TEXTILE MILL SUPPLY COMPANY
GREENVILLE: CAROLINA SUPPLY COMPANY

SCIENTIFIC LUBRICANTS FOR TEXTILE MACHINERY

SLO-FLO is a non-spattering, non-dripping lubricant designed especially for the economical and efficient lubrication of Textile Machinery. No lubricant has proved so genuinely satisfactory, and its adoption and continued use by many of the largest of the country's Textile Mills is evidence of its splendid qualities.

SLO-FLO means better lubrication. Better lubrication means increase in machine efficiency and improved production. And repairs will be less frequent.

SLO-FLO is made in amber and white grades in a series of densities from very thin to heavy—a range covering the requirements of every type and part of Textile Machinery, from bale breaker to spindle.

Samples, recommendation chart which shows at a glance the specific density of Slo-Flo for each bearing, and booklet on Textile Machinery lubrication, will be sent upon request.

QUALITY OILS AND GREASES SINCE 1853

RODNEY HUNT MACHINE CO.

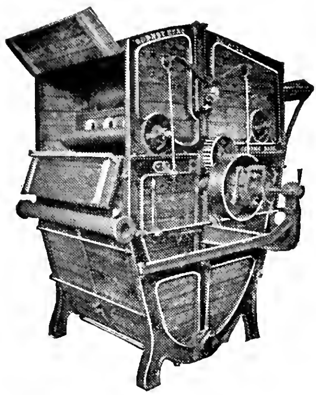
ORANGE, HUNT SUPERIOR QUALITY MASS.

MANUFACTURERS OF TURBINE WATER WHEELS, PIPES, PENSTOCKS AND FLUMES, WATER CONTROLLING APPARATUS, POWER TRANSMISSION EQUIPMENT, UNDERWRITER ROTARY FIRE PUMPS, TEXTILE WET FINISHING MACHINERY.

Southern Representative,
H. G. MAYER, CHARLOTTE, N.C.

Export Representative,
A. W. BUHLMANN, 200 FIFTH AVE., NEW YORK.

WET FINISHING MACHINERY

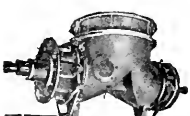


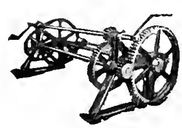
For dyeing, bleaching, rinsing, washing, scouring and fulling goods in the string or roll. Specialization in this class of textile machinery has permitted standardization with its resulting lower costs as well as the development of improvements increasing the dependability and output of the machinery and lowering the maintenance cost. All HUNT Textile Finishing Machinery has standardized and interchangeable parts.

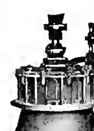
ROLLS FOR EVERY PURPOSE

Made entirely in our own plant. Properly seasoned for the particular work for which they are designed and from the best of wood. A feature of The HUNT Roll Service is prompt shipments and long life rolls.

WATER CONTROLLING APPARATUS



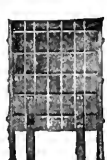


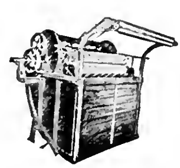


Hunt Turbines, the result of over forty years' experience in building turbines to give the greatest power with maximum speed and efficiency. Complete accessory equipment. Relief Valves and Gauges, Gates and Valves, Gate Hoists and Floor Stands, Penstocks and Flumes, HUNT Screens. HUNT Rakes for Trash Racks are made of pressed steel, deep basket and end teeth guards, eliminating interference with screen back bars.

Write for Catalogs

Sent free
on request.





NATIONAL VENEER PRODUCTS CO.

OFFICES AND WORKS, MISHAWAKA, IND.

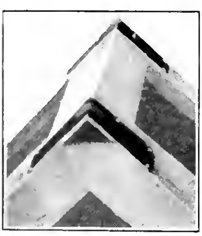
Manufacturers of

INDESTRUCTO INDUSTRIAL TRUCKS

"Indestructo Trucks are built by the Indestructo Trunk Folks."

Indestructo Industrial Trucks embody these two exclusive Indestructo features: First, three-ply laminated panels constructed from best grade of hard-wood lumber and our special process glue which has made Indestructo Trunks the standard of the world. Second, especially designed hardware, including ribbed corner pieces which are absolutely rigid and which insure permanent strength.

Besides their strength, durability and lightness, Indestructo Industrial Trucks cost less than fibre trucks. The Indestructo Folks will give you detailed information, including prices, on the particular type of truck best suited to your needs if you will give them details of your truck needs.



INBUILT STRENGTH IN INDESTRUCTO TRUCKS

Rugged strength characterizes the Indestructo Industrial Truck. Note the shoe which protects the underside of the corner. These trucks are built by an organization which is devoted exclusively to the manufacture of laminated wood products. Special machinery and exclusive methods have been developed to build up and maintain a reputation which is world-wide.

THE BALDWIN CHAIN AND MANUFACTURING CO.

MAKERS OF POWER TRANSMISSION CHAINS AND SPROCKETS

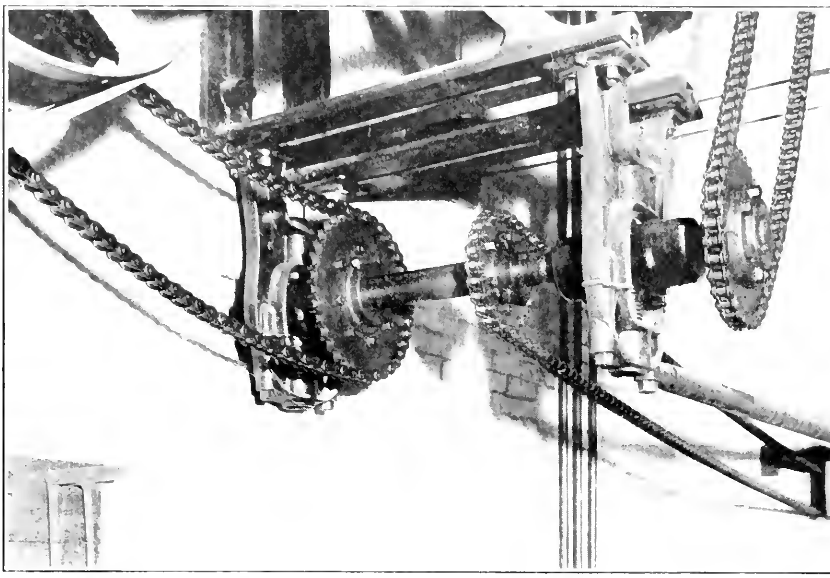
WORCESTER, MASS.

REPRESENTATIVES

Boston, Mass. .... Walter H. Williams, 175 Massachusetts Ave.
St. Louis, Mo. .... American Auto Supply Co.
San Francisco, Cal. .... M. A. Bryte, Inc., 513 Golden Gate Ave.
New York, N.Y. .... C. D. Schmidt, 276 Canal St.
Chicago, Ill. .... W. D. Foreman, 1607 Prairie Ave.
Cleveland, Ohio .... M & M Co.
Philadelphia, Pa. (also the Southern States) .... N. A. Petry Co., Inc., 1307 Race St.
Kansas City, Mo. .... Motor & Machinist's Supply Co., 1619 Grand Ave.
St. Paul, Minn. .... C. J. Smith Co., 153 West Fifth St.
Cincinnati, Ohio .... Wirthlin-Mann Co., 320 W. 3rd St.
Minneapolis, Minn. .... J. M. Howe, 215 Plymouth Bldg.

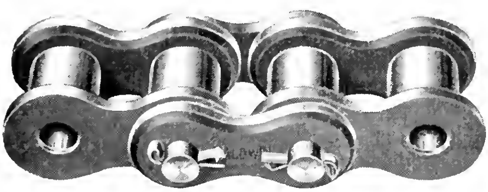
General Sales Agent, H. V. Greenwood, 122 So. Michigan Blvd., Chicago, Ill.

Canada, Lyman Tube & Supply Co., Montreal, Toronto.



BALDWIN CHAINS AND SPROCKETS

are replacing belts for power transmission in textile plants because they're flexible, yet positive, they never slip and are not affected by moisture or humidity. Every mill has at least one drive that eats up belts. You know your greatest trouble-maker—let us submit an estimate.



Chain Drives do away with the endless chain of bills for belts, belt dressings, repairs, shut-downs, and save fuel, power, trouble and space. Our engineering department would like to show you figures on comparative costs.

MORSE CHAIN CO.

Boston	Main Office and Works	Greensboro
141 Milk Street	ITHACA, N.Y.	N.C.

Atlanta, Earl F. Scott, M.E., 702 Chandler Bldg.
Chicago, Merchants L. & T. Bldg.
Cleveland, 421 Engineers Bldg.
Detroit, 1003 Woodward Ave.
Kansas City, Mo., Morse Engrg. Co., Long Bldg.
Minneapolis, Strong-Scott Mfg. Co., 413 3rd St.
New York, 50 Church St.
Pittsburgh, Westinghouse Bldg.
St. Louis, Morse Engrg. Co., Chemical Bldg.
San Francisco, Monadnock Bldg.

Jones & Glassco, Reg'd Montreal and Toronto, Canada

MORSE CHAIN COMPANY ITHACA, NEW YORK

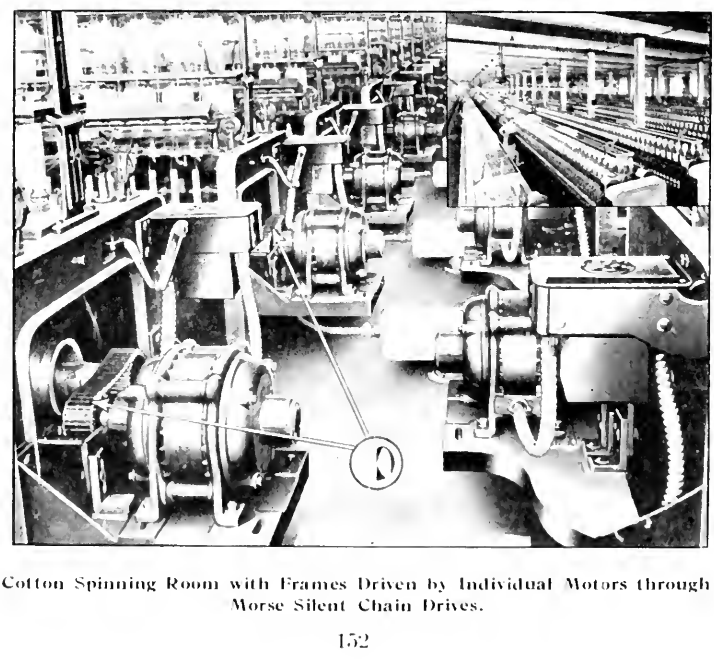
MORSE SILENT CHAIN DRIVES

The Chain with the
ROCKER JOINT

COMPACT — DURABLE — EFFICIENT

Special information and estimates furnished
for any application

Send for Textile Bulletins



Cotton Spinning Room with Frames Driven by Individual Motors through Morse Silent Chain Drives.

MORSE CHAIN CO.

MAIN OFFICE AND WORKS

ITHACA, N.Y.

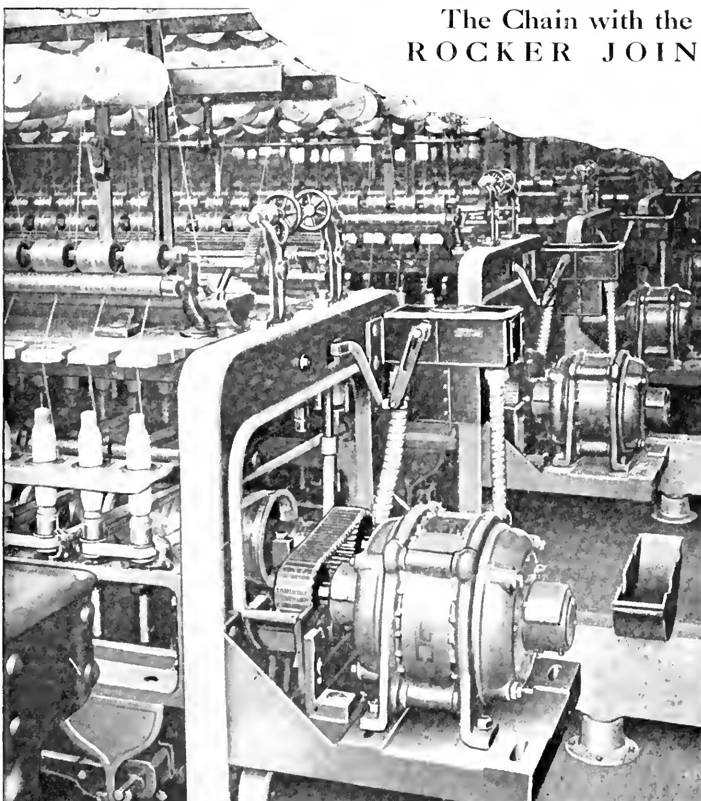
BOSTON 141 MILK STREET	GREENSBORO N.C.

MORSE SILENT CHAIN DRIVES

Provide a Flexible Gear Connection between Individual Motors and Cotton Spinning Frames and Twisters.

They Insure a Constant Speed for the Cylinder Shaft, Run Smoothly and Without Vibration.

Let us Prove to you that this means an INCREASED PRODUCTION from the Frames—a STRONGER YARN.



End View of Cotton Twister Frame with 5 H. P. Individual Motor and Morse Silent Chain Drive.

AMERICAN MOISTENING COMPANY

120 Franklin Street, BOSTON, MASS.

William Firth, President — Frank B. Comins, Vice-Pres. and Treas.

southern office: Atlanta, Ga.

EXPERIENCE HAS DETERMINED that no feature of a **Textile Equipment** shows **greater returns for the money invested** than a HUMIDIFYING SYSTEM as installed by us.

We have Hundreds of Testimonials substantiating this statement, which, however, needs no other endorsement than is shown by the large number of equipments we are installing.

FOR THE YEAR 1918

our orders for **TEXTILE MILL EQUIPMENTS** alone **aggregate nearly 200 installations** from mills using our various Humidifying Appliances and kindred devices, many of whom have been our clients for **more than a quarter of a century.**

Over 1,000 users of our system bear testimony to the **SUPERIORITY** and **EFFICIENCY** of **our equipments.**

Our COMINS SECTIONAL HUMIDIFIERS

Our FAN TYPE and HIGH DUTY HUMIDIFIERS

Our VENTILATING TYPE of HUMIDIFIER
(Taking fresh air into the room from the outside)

Our ATOMIZER or COMPRESSED AIR SYSTEM

Our COMPRESSED AIR CLEANING SYSTEM

Our CONDITIONING ROOM EQUIPMENT

Our AUTOMATIC HUMIDITY CONTROL
(Can be applied to systems already installed)

Our AUTOMATIC TEMPERATURE CONTROL

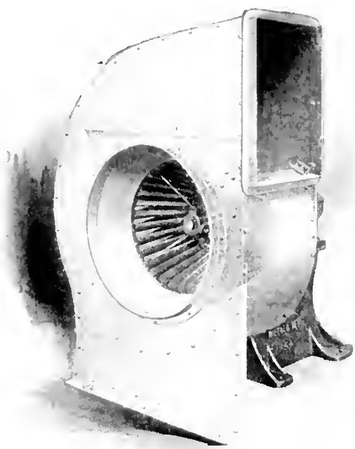
Our COMINS ELECTRO PSYCHROMETER

ARE ALL STANDARD OF MODERN
TEXTILE MILL EQUIPMENT

BUFFALO FORGE CO.

BUFFALO, N.Y.

Write Department 23



Eliminate Steam in your Dyehouse

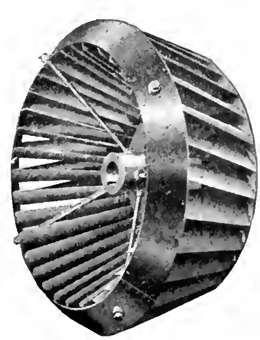
If you could keep the air in your dyehouse warm and dry you would never have any steam. The troublesome condensation, that rots your roof, ruins your goods by dripping, and is dangerous to the workman, is nothing more or less than steam which has suddenly been chilled by coming in contact with the outside air or the cold walls and roof.

The "Buffalo" Hot Blast System

eliminates it entirely. By blowing a stream of warm *dry* air along the walls and roof the moisture does not get a chance to condense.

THE BUFFALO WAY IS POSITIVE—IT IS GUARANTEED

Save your buildings and goods—protect your workmen. Simply put your problem up to our Engineering Department; they will be only too glad to co-operate with you—no charge.



PARKS-CRAMER COMPANY

SUCCESSORS TO THE G. M. PARKS CO., AND STUART W. CRAMER

MANUFACTURERS OF HUMIDIFYING APPARATUS

FITCHBURG, MASS.

BRANCH OFFICES

BOSTON, MASS., 1102 OLD SOUTH BUILDING — CHARLOTTE, N. C.

TURBO-HUMIDIFYING SYSTEM; AIR WASHERS; HUMIDIFIERS. COOLERS; AUTOMATIC HUMIDITY AND TEMPERATURE REGULATORS; PSYCHROMETERS; DIAPHRAGM VALVES; CONDITIONING EQUIPMENTS.

TURBO TRADE MARK HUMIDIFIER

Diaphram Humidity and Temperature Regulator

TURBO-HUMIDIFYING SYSTEM.

The Turbo-humidifying system imparts additional humidity or moisture to the air in factories or other buildings.

Air under pressure is supplied through a main pipe to the several branch lines in which the heads are located. Parallel with these branch air lines are water lines. These are run dead level.

Water is supplied through a covered, float controlled tank. This tank is equipped with overflow pipe, draw-off pipe, filter, etc., and is covered to keep out dust and lint. The supply tank is a special one, but is about the size of that furnished with any complete toilet room set.

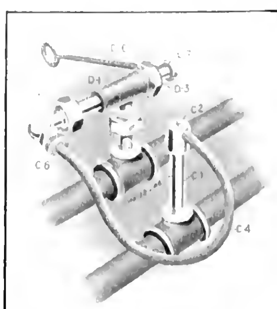
One of the tanks will supply from 60 to 70 heads, but in large rooms the best practice is to divide the system into 2, 3 or 4 separate sections. Tanks may be located in toilet rooms, or other convenient, accessible places.

It is absolutely impossible for water to overflow from the heads on floors, machinery, stock, etc., for when the air is shut off there is no power to lift the water up to and into the head.

The centrifugal motion imparted to the air by the turbo principle actually pulverizes the water before it is delivered to the atmosphere. The importance of this centrifugal action is noted, since it spreads the vapor and distributes it before condensation can occur.

The water inlet to the head is connected to the riser nipple, C-1, in the water branch pipe by means of a non corrosive, flexible, metallic tube, C-4, which being provided with union connections, B 2, C 6, makes all parts readily accessible and adjustments easy. Two unions, one vertical and the other horizontal, make it possible to point the jet in any direction.

The turbo valve or cock, D 1, is so located that any head may be shut down without interfering with the others. Simply shutting off the air shuts down the head.



Detail of Piping and Installation of Turbo Head

COMPRESSED AIR CLEANING.

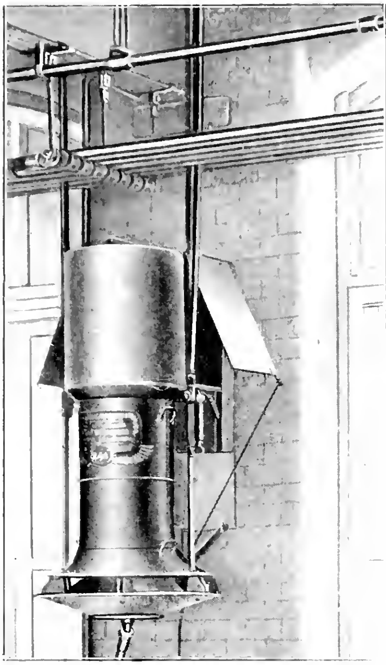
The next most profitable use of compressed air from the Turbo-humidifier system applies directly to the manufacturing departments through its utilization in cleaning the mill and its machinery.

A hose specially designated for this service and a special cleaning nozzle with operating lever is supplied.

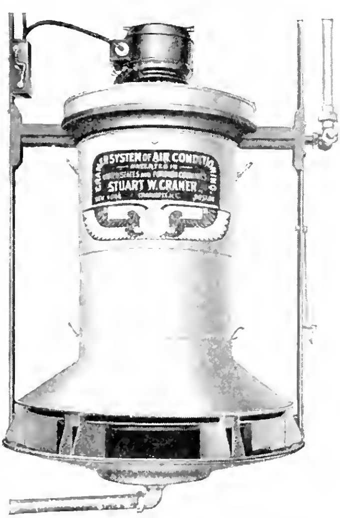
The use of compressed air is the easiest and most economical method of cleaning mill machinery. Write for complete details of this service.

PARKS-CRAMER COMPANY

(Continued)



Ventilating Fan Air Conditioner



"High Duty" Copper Fan Air Conditioner

DIAPHRAGM HUMIDITY AND TEMPERATURE REGULATOR.

The essential features of this instrument are the metallic members, expanding and contracting with changes in temperature.

These movements are positive, and of such magnitude that they can be used without multiplication to open and close valves, and thereby produce a most simple and effective machine for this purpose.

In this machine the spray method of maintaining the wet bulb temperature without rags or wicks is used, and this part of the device needs no attention.

VENTILATING FAN AIR CONDITIONERS.

This type of equipment lends itself admirably to ventilating purposes, and is usually arranged with a thimble in the pilaster, or a direct duct connection to the transom on either side, so that part or all of the air drawn through the fan can be brought from out of doors. This head will handle 60,000 cu. ft. of air per hour, and in warm weather reduces it to the wet bulb temperature; while in winter, if hot water is used, as is ordinarily the case, warm tempered air is introduced

COPPER FAN AIR CONDITIONERS.

(High Duty)

This air conditioner produces, with approximately the same power expenditure, enormously increased results, both in air handling and water evaporative capacity.

It is the only really successful fan humidifier made. The only one that does not blow out drops of water, and that has an instantly accessible interior, with perforated copper pan strainer, and a fan motor removable without bothering with bolts or screws.

To take the fan off, merely lift it off. It cannot fall off, as it is secured in a heavy iron ring while in a running position.

CENTRAL STATION EQUIPMENT.

Sometimes it is merely desirable to humidify, sometimes to air-wash or to heat, but more frequently to combine either two or more of these features in the same plant and at the same time to automatically control both the temperature and humidity.

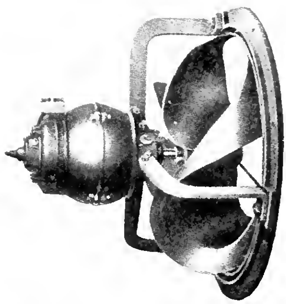
The design of inside cover is such that the spray is discharged in a flat horizontal plane, and not drawn back into fan at the top. Local circulation and wet spots around each head are thus avoided.

The smooth outside surface presents no unusual humps to be filled with floating lint, and its size is small compared with its evaporative and air handling capacity.

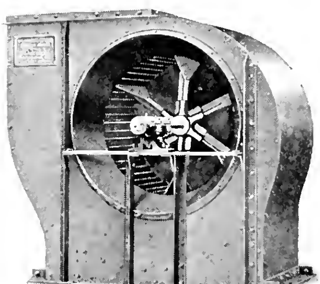
MASSACHUSETTS BLOWER CO.

WATERTOWN, MASS.

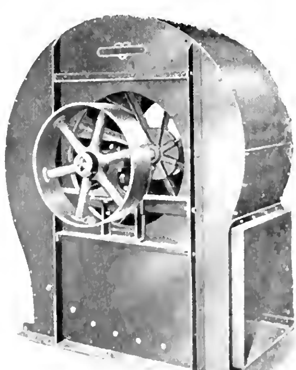
BOSTON, MASS., 247 Atlantic Ave.
ATLANTA, GA., 57 East 13th St.
BALTIMORE, MD., 100 West Fayette St.
ST. PAUL, MINN.
NEW YORK, 103 Park Ave.
CHICAGO, ILL., 1229 South Michigan Ave.
CLEVELAND, OHIO, East 49th St. and Hamilton Ave.
OKLAHOMA CITY, Oklahoma.



MASSACHUSETTS-DAVIDSON PROPELLER FAN WITH DIRECT CONNECTED MOTOR



MODIFIED SQUIRREL CAGE FAN



STEEL PLATE FAN

Manufacturers of FANS, BLOWERS, HEATERS and AIR WASHERS for Heating, Ventilating, Purifying, Cooling, Humidifying, Dehumidifying; Forced and Induced Draft, Commercial Drying and Blast Equipment.

MASSACHUSETTS SQUIRREL CAGE FANS

Meet every requirement for heating, ventilating drying and mechanical draft. In all sizes from six inches up. Either belt or direct drive.

MASSACHUSETTS-DAVIDSON PROPELLER FAN.

For pulley drive or direct drive from motor or engine. In all sizes from 12 in. diameter up.

MASSACHUSETTS STEEL PLATE FANS

For all heating and drying requirements including conveying.

CONE FANS

Designed for installations where conditions will not permit the usual housings.

PIPE COIL HEATERS

Massachusetts Pipe Coil Heaters are built to meet all requirements for hot water and steam. Adapted for high and low pressure work.

AIR WASHERS

For purifying, cooling, humidifying and dehumidifying, for industrial and commercial purposes. Made in all sizes.

The data compiled by our engineering department on all problems of ventilation, humidifying, conveying, etc., is at your disposal for the asking.

WESTINGHOUSE ELEC. & MFG. CO.

EAST PITTSBURGH, PA.

Westinghouse Motor Drive

If your mill drives have not kept up with the demand for increased production, it will pay you to investigate WESTINGHOUSE MOTOR DRIVES.

WESTINGHOUSE SERVICE is based on fifteen years' experience in designing, building, and testing electrical equipment for textile mills.

Westinghouse Electric & Mfg. Co.

EAST PITTSBURGH, PA.

W
WESTINGHOUSE ELECTRIC

ARTHUR S. BROWN MANUFACTURING COMPANY

Manufacturers of

TILTON PATENTED ENDLESS BELTS

TILTON, N. H.

ENDLESS
TILTON
WOVEN BELTS

An Endless, Spliceless, Stretchless Fabric Belt

The Tilton Belt is made of high quality, long staple Sea Island Cotton.

Tough and pliant, it is not affected by moisture or oil. It will not lengthen and is capable of hard wear. No seams, no splicing, no lacing, no bumps, no pounding.

The Tilton Endless Belt assures greater efficiency and longer wear—hence economy. Our booklet "An Endless Tale" shows you why you should use the Tilton absolutely endless fabric belt instead of one that is spliced.

THE BIGELOW COMPANY

WORKS AND MAIN OFFICE

76 RIVER ST., NEW HAVEN, CONN.

NEW YORK OFFICE, 85 Liberty St. BOSTON OFFICE, 144 Milk St.

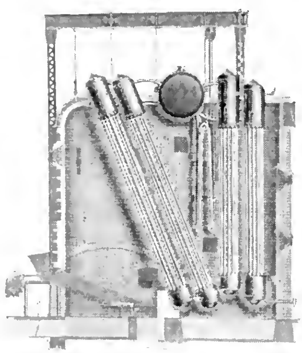
SOUTHEASTERN OFFICE, Realty Building, Charlotte, N.C.

Manufacturers of Fire Tube and Water Tube Steam Boilers, Heavy Plate Steel Work.

THE BIGELOW-MANNING BOILER

This type of boiler can be constructed suitable for 200 pounds working pressure or more, in units up to 500 H.P. The shell sheets being away from contact with the fire permits the use of any thickness of shell necessary for high pressures. Another feature conducive to safe operation is the firm support of the boiler, which is accomplished in the Bigelow-Manning type by having a firm foundation upon which the cast iron base rests, without relying upon the support of setting walls.

The economical evaporative performance of the Bigelow-Manning Boiler is remarkable. All radiant heat from the fuel bed is absorbed directly by water heating surface, the distribution of the furnace gases over the heating surface is practically uniform, the superheat furnished is varied by changing the water level, there are no losses due to the infiltration of air in the setting and stand-by losses are comparatively small, occupying per H.P. much less ground space than other types.



THE BIGELOW-HORNSBY WATER TUBE BOILER

Some of the features of the Bigelow-Hornsby Boiler that meet the requirements of Modern Power House Practice:

Unlimited size of units.

Small ground space occupied.

Coldest water meets the coldest gases.

Direct heating surface about four times as great as the average water tube boiler.

All parts, both external and internal, readily accessible.

All boiler tubes perfectly straight.

Circulation of water and liberation of steam unrestricted.

Very dry steam, also ample room for superheaters where required.

High continuous economy due to extreme cleanliness of the most efficient heating surface.

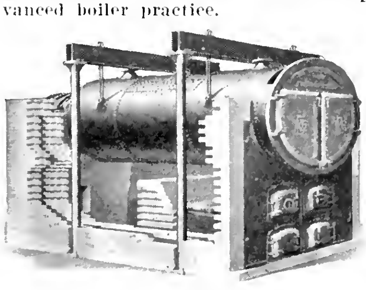
Arrangement of baffling is such that the gases pass over the heating surface in thin streams and uniformly at every point.

Furnace arrangement is ideal for securing perfect combustion, as furnace is correctly shaped and of ample size.

Greatest flexibility, both as to construction and in steaming qualities.

No cast iron used in any portion of the boiler proper.

Constructed both as to workmanship and material in accordance with the most advanced boiler practice.



HORIZONTAL RETURN TUBULAR BOILER

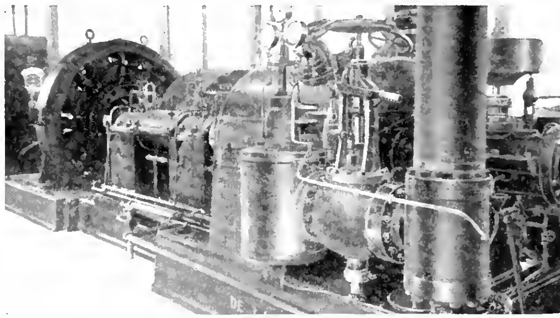
The advantage of compactness and efficiency, large direct heating surface, easy cleaning, large liberating surface, perfect circulation and minimum liability and ease of repairs are well-known features of this type.

Our boilers are constructed in the most approved manner; we adopt the very highest type of professional and mechanical service, maintain the highest possible standard of efficiency, and believe our facilities for boiler construction are without a parallel.

DE LAVAL STEAM TURBINE CO.

TRENTON, NEW JERSEY

CUT OUT POWER WASTING INTERMEDIARIES


De Laval multi-stage Geared Turbine driving 400-kw. D. C. generator in cloth finishing and dyeing plant. The exhaust steam is used for manufacturing and heating.

A De Laval Geared Turbine connected directly to shafting or with rope or belt transmission utilizes at least 98% of the power generated exclusive of belt or rope losses as against 80 to 90% with electric drive.

Direct current, if needed, should be generated by a De Laval Geared Turbo-generator, thus saving transformer and converter losses.

Where low pressure steam is required for heating or manufacturing operations, the steam turbine, in addition to its advantages of compactness, simplicity, reliability, and freedom from reciprocating parts and vibration, has the additional great advantage that the exhaust steam contains no oil and can be used directly in tubs or vats, will not coat heating coils or rolls with grease, and after condensation can be returned directly to the boiler.

If you have a permanent or intermittent surplus of exhaust steam, install a De Laval low-pressure or mixed flow turbine and convert it into power.


1800 hp. De Laval Geared Turbine and rope drive. Installed in a large textile mill.

De Laval Steam Turbines are made in all sizes from 1 to 15,000 kw. and for all steam conditions.

The advice and suggestions of our engineers, rendered free, will show you ways to improve greatly the economy of your steam power plant. Ask for Special Publication.

D. M. DILLON STEAM BOILER WORKS

WORKS AT

FITCHBURG, MASS.

NEW YORK OFFICE
30 CHURCH STREET

Southern Representative
J. S. COTHRAN
CHARLOTTE, N.C.

Established 1870 Incorporated 1906

SPECIALTIES

Horizontal Return Tubular Boilers

Manning and Plain Upright Boilers

Scotch Marine Type Boilers

Locomotive Boilers

Rotary Bleaching Kiers

Upright Bleaching Kiers

Steel Tanks of All Kinds

Smoke Stacks and Flues

Heavy Steel Plate Work

Patent Shaking Grates

ANNUAL CAPACITY 100,000 BOILER HORSE POWER

THE GREEN FUEL ECONOMIZER CO.

BEACON, N.Y.

Boston Office	New York Office	Atlanta Office
141 Milk Street	90 West Street	905 Healy Bldg.

GREEN'S ECONOMIZERS, GREEN'S HI-EFFICIENCY HI-SPEED RADIAL FLOW FANS, GREEN'S STEEL PLATE FANS, MECHANICAL DRAFT APPARATUS.

Green's Economizer consists of a number of cast-iron tubes and headers through which the feed-water passes on its way to the boiler and around which the waste gases of combustion pass on their way to the stack.

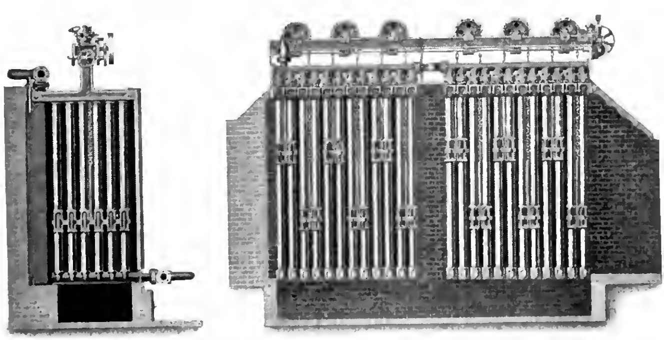
The purpose of the Economizer is to heat the feed-water to a high temperature, before it enters the boiler, by means of the heat contained in the flue gases when they leave the boiler.

The rise in feed-water temperature thus gained from heat which would otherwise be wasted results in a greater evaporation in the boiler per pound of fuel burned and a corresponding fuel saving, or if desired, the same amount of fuel may be used with a proportional increase in steaming capacity.

The average saving or increased capacity obtained by installing an Economizer varies from 10 to 15 per cent., depending upon plant conditions, although in many cases greater savings have been made.

Economizers show an unusually high return on the investment, due to the large saving in proportion to the small cost of installation, and they should be used in almost every boiler plant, especially as the conservation of fuel is a matter of national importance.

Our Engineers will be glad to show you the results obtained in large textile mill and other installations, also make suggestions for your own conditions.

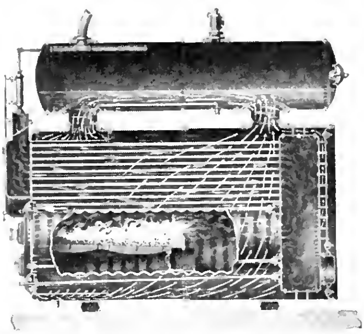


Sectional View of Green's Economizer as Installed

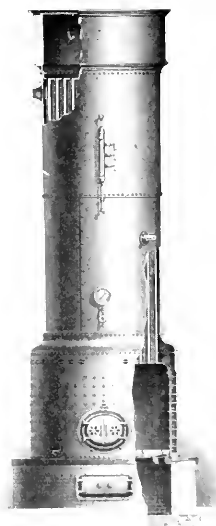
INTERNATIONAL ENGINEERING WORKS, INC.

WORKS: FRAMINGHAM, MASS. BOSTON OFFICE: BOARD OF TRADE BLDG.

HIGH PRESSURE STEAM BOILERS
STEEL PLATE WORK OF EVERY DESCRIPTION

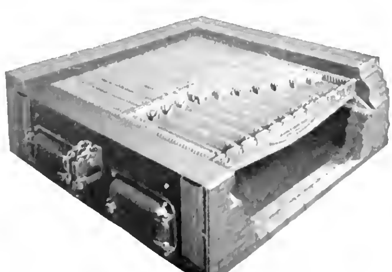


BRADY SCOTCH BOILERS give high efficiency by combining rapid positive circulation and internal firing. No brickwork. Minimum repairs.



VERTICAL TUBULAR BOILERS All the best features of both Manning and straight shell types—minimum space per horse power, designed for the higher steam pressures. Superior construction. Improved fire door opening.

HORIZONTAL RETURN TUBULAR BOILERS constructed according to the rigid requirements of the Massachusetts Board of Boiler Rules.



MACDONALD SHAKING GRATES give more efficient combustion, save fuel and increase boiler capacity. Powerful leverage for shaking and breaking up clinker, fool proof locking device, adjustable air openings, unrestricted air passages.

THE WALSH & WEIDNER BOILER CO.

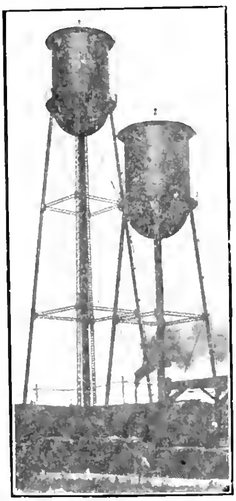
CHATTANOOGA, TENN.

BRANCH OFFICES

NEW YORK	BIRMINGHAM	NEW ORLEANS	DALLAS
11 Broadway	Brown-Marx Bldg.	Hibernia Bank Bldg.	Busch Bldg.

Manufacturers of

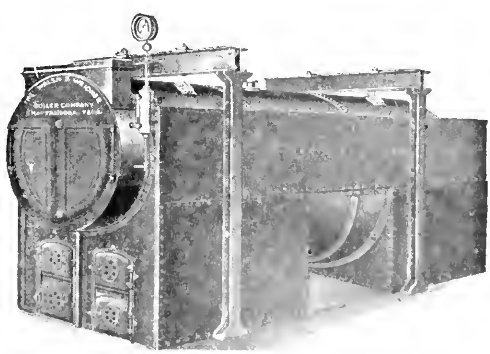
BOILERS, OF WATERTUBE AND TUBULAR TYPES



STEEL CASINGS, TOWERS AND TANKS, STEEL BUILDINGS AND STRUCTURAL WORK

Our towers and tanks are built of the best materials by expert workmen according to Insurance Specifications and are erected by experienced erection crews. We are prepared to make prompt deliveries. Full specifications furnished on request.

Steel casings are used because they save fuel by preventing air infiltration, occupy less space than brick setting and require considerably less brick, and in addition they present a very neat appearance.



Write us for Catalogue

THE WICKES BOILER CO.

Manufacturers of Steam Boilers

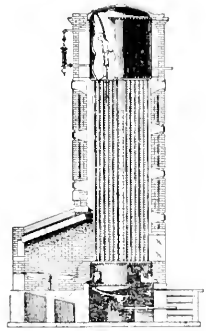
WICKES VERTICAL WATER TUBE BOILERS AND STEEL CASED BOILER SETTINGS

Water Tube Boilers have proved their efficiency. The need is for simple, reliable, durable, thermally efficient boilers. The Wickes Vertical Water Tube Boiler has proven its superiority.

1st. It is simple and mechanical in design.

2nd. It is constructed entirely of homogeneous material, in accordance with the A. S. M. E. Boiler Code; uses straight tubes; fabricated with the highest grade of workmanship; and with the closest tolerances in construction.

3rd. In operation it is reliable, accessible, operates the greatest number of days per year, and delivers absolutely dry steam with the highest possible thermal efficiency.

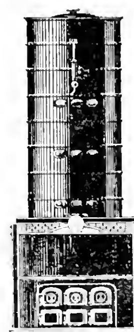


Man Stands Erect Cleaning

Consider the cleaning, for example:

To wash a Wickes Vertical Water Tube Boiler two 12" x 16" manholes open in this boiler—one top—one bottom. Every tube can be looked through, washed or turbined. Two men can do the job thoroughly in not more than five hours, at an average cost of $2.20 per cleaning.

To clean some boilers, where a hand-hole plate at both ends of each tube must be removed, requires an average of six days' work for two men, at a cost of $19.00 per cleaning.



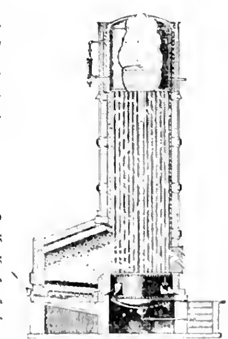
Steel Cased Setting

Consider the question of efficiency:

HIGH FURNACE TEMPERATURE results from Dutch oven. Gases entirely surround and closely *scrub heating surface* from entrance to release. The gases cannot leave heating surface. There is no possible chance for short-circuiting. The boiler heating surface absorbs the heat—empty pockets in setting lose heat. There are no empty pockets in this boiler. A VERY LONG GAS TRAVEL—hence long contact with heating surface is provided. Heat absorption is, therefore, assured. *The steel cased settings are always* tight. No cracked, warped, leaky, defective and unsightly settings exist with this type. A steel cased setting is a simple and sure cure for air infiltration losses. The largest preventable losses we have to contend with in boiler efficiency are excess air losses.

Consider carefully steam quality:

Did you ever wreck an engine by pulling water over into it from the boiler? Study this boiler. The steam drum gives great height from water line to steam outlet nozzle. This height provides room for separation of the steam from the water, which is entrained with it at a point close to the surface of liberation. Since the shell is subject to a mild degree of heat some superheat is effected on the steam leaving this boiler. *You do not pull water over from this boiler.*



Great Height of Steam Space

THE WICKES BOILER CO.

SAGINAW, MICHIGAN

Sales Offices:

NEW YORK CITY BOSTON CHICAGO DETROIT
PITTSBURG SEATTLE

STARKWEATHER & BROADHURST, INC.

POWER PLANT EQUIPMENT PUMPING MACHINERY
PERMUTIT WATER FILTERS AND SOFTENERS

53 STATE STREET, BOSTON, MASS.

NEW ENGLAND SALES AGENTS FOR

THE GRISCOM-RUSSELL CO.—Reilly and Goubert Heaters, Bundy and Stratton Separators, Reilly Multiscreen Feed Water Filters.

A. L. IDE AND SONS—Ideal Single and Corliss Valve Engines, Direct Connected or Belted.

MORRIS MACHINE WORKS—Centrifugal Pumps all Capacities, Steam, Electric, or Belt Drive.

THE PERMUTIT CO.—Clarifying and Water Softening Filters.

JOS. H. ROACH & CO., INC.—Centerfeed Stokers.

THE RUST ENGINEERING CO.—Concrete and Radial Brick Stacks, Boiler Settings.

UNION IRON WORKS—Water Tube and Fire Tube Boilers.

C. H WHEELER MFG. CO.—Surface Jet and Barometric Condensers and Water Cooling Towers.

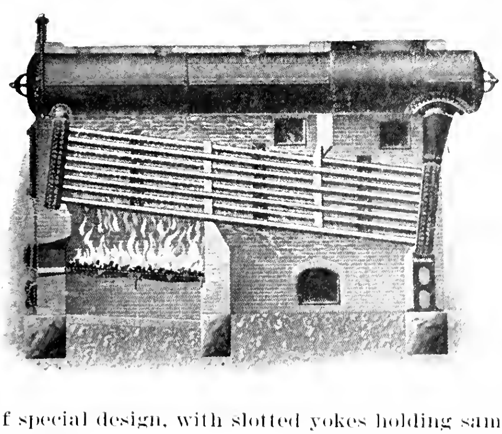
SPRAY COOLING SYSTEMS USING SIMPLEX PATENT NOZZLES

"EVERYTHING BUT THE TURBINE"

UNION IRON WORKS

MANUFACTURERS OF STEEL BOILERS

ERIE, PA.



UNION WATER TUBE BOILERS

Built in sizes from 100 to 1000 H. P. and A. S. M. E. or Massachusetts Standards.

They are unequalled for free steaming and overload capacity, due to the splendid circulation. The connection between drums and rear headers is made by means of a corrugated flanged joint, which provides for expansion and contraction. Hand-holes are of special design, with slotted yokes holding same, and each cover is separately removable through its own opening. Feed water enters special settling chamber at rear of drums, outside of the setting. Boilers arranged for any type of furnace or superheater.

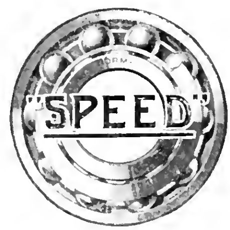
THE NORMA COMPANY OF AMERICA

1790 Broadway, New York

BALL, ROLLER, THRUST, COMBINATION BEARINGS

TRADE "NORMA" MARK

The distinguishing features of "Norma" Ball Bearings are extremely high precision, open type of construction, and rigid mounting of both races. This eliminates all looseness and wear in the housing, absolutely forbids vibration, and therefore results in silent running even at the highest speeds.



This silent-running characteristic of "NORMA" Bearings, coupled with their proved serviceability at high speeds, recommends them pre-eminently for use in spindle bearings for textile purposes. Here high speed must be carried, interruption to service is to be avoided wherever possible, and noise reduced—all of which are accomplished by "NORMA"-mounted spindles.

"NORMA" speed qualities, in spindle bearing service, bring about three highly desirable results. They require the minimum of lubricant while giving the maximum of service. Their open type and separable construction permit quick and easy spindle replacement when necessary. Their high anti-friction qualities maintain a more uniform yarn tension and produce a better product.

"NORMA" engineers, specialists in the application of anti-friction bearings to high speed conditions, offer their services and suggestions to all interested in securing in highest degree the advantages and economies which come with the minimizing of bearing friction and wear. This service can be had without obligation.

WM. B. SCAIFE & SONS CO.

Founded 1802

NEW YORK OFFICE
26 CORTLANDT ST.

OAKMONT, PA.

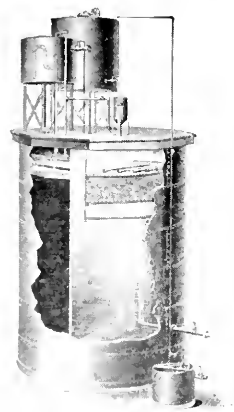
PITTSBURGH OFFICE
FIRST NAT'L BANK BLDG.

Water Purification for All Purposes: Continuous and Intermittent Water Softening and Purifying Systems; Pressure and Gravity Filters and Filtration Systems.

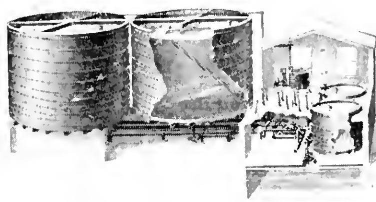
Scaife Water Softening and Purifying Systems

The fundamental features of all our designs of systems are accurate chemical treatment, thorough mixture of reagents with water, accelerated chemical reaction, rapid sedimentation, and perfect clarification. Design for each installation and performance guarantees are based upon scientific investigation of water supply and uses, supplemented by analysis and treatment of water in our own laboratory.

We-Fu-Go System—(Intermittent): In this system definite quantities of water are treated, therefore accuracy of treatment can be maintained and uniform water obtained regardless of variations in quality of raw water or rate of use. Consists essentially of two or more reaction and settling tanks, which also act as storage tanks, fitted with mechanical stirring devices operated by power, a small reagent mixing tank, means for introducing the reagents into the reaction tanks, and a quartz filter of either gravity or pressure type. Built for any capacity.



Syphon System (Patented)



We-Fu-Go System (Patented)

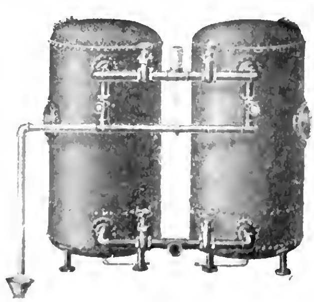
Syphon System—(Continuous): An automatic system not dependent upon moving mechanical devices for reagent introduction. The water enters a receiving tank to which is connected a syphon, into the long leg of which smaller syphons connect from the solution tanks. Reagents introduced during the period of syphon discharge. This system can be arranged to be operated either from the ground or from the top. In addition we manufacture three other standard continuous systems and design special systems where required.

Pressure and Gravity Filter Systems

Pressure Filters are adaptable for every purpose and are built in capacities from 20 gallons per hour upward, to withstand any required pressure. When operated in pairs, each filter is cleaned with filtered water, one filter furnishing the water for cleansing the other.

Gravity Filters are built in units with capacities varying from 8,000 to 1,000,000 gallons per 24 hours each. Combinations for practically any capacity with required sedimentation can be furnished.

Patented brass conical strainers and patented valveless coagulant feed apparatus are special features embodied in these filters and filter systems.

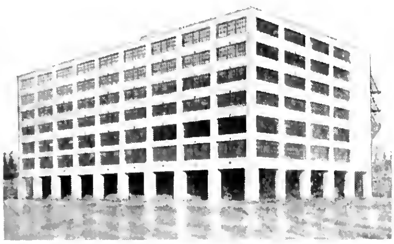


Pressure Filters

ABERTHAW CONSTRUCTION CO.

27 School Street, BOSTON, MASS.

CONSTRUCTING ENGINEERS



AMERICAN THREAD CO.,
Willimantic, Conn.

Aberthaw Construction Service essentially comprises the organization and management of construction work. For the successful handling of this work many men have been carefully selected and trained into an efficient, permanent group from which skeleton organizations are made up to carry through various undertakings. In the textile field these include the building of mills, storehouses and industrial villages, print works, bleacheries and dyehouses, power houses, dams, head gates, tanks, etc. Sincerity of purpose and a reputation for building only the best have made the phrase "Built by Aberthaw" a mark of distinction.

MILLVILLE MANUFACTURING CO., Millville, N.J.

JOHN W. FERGUSON CO.

253 Broadway, NEW YORK

152 Market Street, PATERSON, N.J.

Interior of Weave Shed, Brighton Mills, Allwood, N.J.

New Buildings for Old Clients

Repeat orders have come to represent a large part of our business—scarcely a month passes that we do not announce a new contract from an old client.

In many plants the increase in the number of buildings built by Ferguson is a direct indication of the increase in the owner's business—in other words, Ferguson has become the building department of the manufacturers.

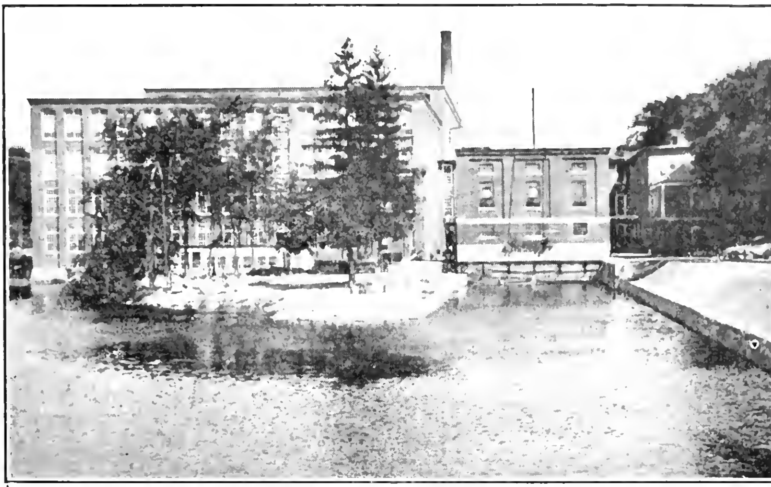
Repeat orders are evidence of work well done, and our organization with the experience gained in 26 years of engineering and contracting work is at your disposal.

FLYNT BUILDING AND CONSTRUCTION COMPANY

GENERAL OFFICES
PALMER, MASS.

NEW YORK OFFICE
30 CHURCH ST.

BUILDING CONSTRUCTION



Mill No. 4. S. M. Greene Co., Engrs. Hydro Electric Power Plant, C. W. Praray, Engr. Buildings for Boston Duck Co., Bondsville, Mass. Both constructed by FLYNT.

Eighty Years of Superior Construction Service

ESTABLISHED 1839
FLYNT
INCORPORATED 1885

Established in 1839, the FLYNT Building Organization has maintained an unbroken record of Superior Service to its clients.

The FLYNT Building Organization was the pioneer in Standard Mill Construction and with the advent of Reinforced Concrete, experts in that field were added to the staff and the FLYNT Organization has maintained its position as the Premier Industrial Building Organization.

FLYNT Built Textile Mills may be seen throughout the Eastern and Southern States and each is a standing testimonial to the high standard of materials and workmanship maintained by the organization.

Our interesting and valuable booklet about Factory Buildings will be sent upon request.

LOWELL TEXTILE SCHOOL

LOWELL, MASS.

Scientific and practical training in all processes of textile manufacture, including all commercial fibres. Complete three-year diploma courses in Cotton Manufacturing, Wool Manufacturing, Textile Designing.

Degrees of B.T.C. (Bachelor of Textile Chemistry) and B.T.E. (Bachelor of Textile Engineering) offered for completion of prescribed four-year courses.

POSITIONS ATTAINED BY DAY GRADUATES, 1899–1918

Directors of textile schools	1
Teachers	8
Mill vice-presidents	2
Mill treasurers and agents	10
Mill superintendents	28
Mill assistant superintendents	14
Mill foremen of departments	12
Assistants to superintendents	1
Mill auditors and accountants	3
Mill clerks	1
Second Hands	4
Managers	24
Textile designers and fabric experts	19
Purchasing agents	3
In commission houses	5
Salesmen	8
Chemists, dyers, and chemical salesmen	54
In U.S. Military Service	40
In U.S. Civilian Service	16
In State employ	1
Textile manufacturing, unassigned	14
Industrial engineering	9
Mill engineering	9
Civil engineering	1
Trade journalists	3
In business, textile distributing or incidental thereto	5
Other business	17
Employment not known	25
Married women	3
Deceased	9
TOTAL	349

Certified graduates of High Schools and Academies admitted without examination.

For catalogue address Charles H. Eames, S.B., President, Lowell, Mass.

THE NEW BEDFORD STATE TEXTILE SCHOOL

AN INSTITUTE OF TEXTILE TECHNOLOGY

NEW BEDFORD, MASS.

William E. Hatch, A.M. President	Frederic Taber Treasurer	James O. Thomson, Jr. Clerk

Situated in New Bedford, Mass., a delightful residential city on Buzzards Bay, and the largest cotton manufacturing city of fine yarns and fancy woven fabrics and novelties in the country.

Instruction given in every phase of cotton manufacturing from the raw cotton to the finished cloth by trained and experienced instructors in every department.

Day and Evening Classes

Tuition free to residents of Massachusetts

Courses of Study:

General Cotton Manufacturing

Chemistry, Dyeing and Finishing — Textile Engineering

Seamless Hosiery Knitting — Designing

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Diplomas awarded for regular courses three years in length. Shorter special courses may be arranged for which certificates are granted.

Free catalogue, giving in detail courses of study, terms of admission, etc., furnished on application.

RHODE ISLAND SCHOOL OF DESIGN

11 Waterman Street, PROVIDENCE, R. I.

The name Rhode Island to many is synonymous with the hum of spindles and the manufacture of fabrics of wool, cotton, and silk. Here in Providence, the centre of great and varied industries, the Rhode Island School of Design is offering courses of instruction in many branches of industry.

THE TEXTILE DEPARTMENT

offers three-year day-courses in Textile Design and Weaving, including Weave Formation, Fabric Analysis, Calculations, Freehand and Mechanical Drawing, Jacquard Design, Warp Preparation, Hand-loom, Power-loom, and Jacquard Weaving and Loom Fixing, also Elementary and Advanced Chemistry.

Besides the day courses the School offers evening courses in most of the above branches including Cotton and Worsted Spinning and Dyeing.

Courses of instruction in other departments are also given, in

Drawing and Painting

Decorative Design

Modelling

Architecture

Mechanical Drawing

Jewelry and Silversmithing

Normal Art

For circular and further information address the office of the Rhode Island School of Design, 11 Waterman St., Providence, R.I.

THE BRADFORD DURFEE TEXTILE SCHOOL

FALL RIVER, MASS.

This school was founded, and is maintained, by the Commonwealth of Massachusetts and the city of Fall River for the purpose of giving its students a broad knowledge of the manufacture of cotton yarn and cotton cloth, also to offer students an opportunity to study subjects closely allied to cotton manufacturing, such as Engineering, and Chemistry and Dyeing.

Four courses of study are offered

1. General Cotton Manufacturing Course . . 3 years
2. Designing and Weaving Course . . . . . 2 years
3. Chemistry and Dyeing Course . . . . . 2 years
4. Engineering Course . . . . 2 years

The training given by these different courses enables the students to take much greater advantage of the many opportunities that are open in these fields of industry. Being situated in the very center of the largest cotton manufacturing city in the country, a city which contains one hundred and twelve mills, representing an investment of over sixty million dollars, this school offers exceptional advantages to the young man who is in earnest. The positions for which the graduates of the courses offered, are in line, and the chances of advancement, are not surpassed by any other field.

To any one interested in the work offered by this school, a catalogue, giving detailed information of all courses, will be sent upon request.

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Victor Balata & Textile Belting Co., New York, N.Y.

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Chesapeake Belting Co., Baltimore, Md.
Imperial Belting Co., Chicago, Ill.
Johnson Belting Co., New York, N.Y.
Main Belting Co., Philadelphia, Pa.
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Parks & Woolson Machine Co., Springfield, Vt. *p. 110*

BRUSHING MACHINES
Butterworth, H. W., & Sons Co., Philadelphia, Pa. *p. 129*
Curtis & Marble Machine Co., Worcester, Mass. *p. 109*
Parks & Woolson Machine Co., Springfield, Vt. *p. 110*
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*

BUILDING CONTRACTORS
(See Contractors, Building)

BUNTERS
Jacobs Mfg. Co., E. H., Danielson, Conn. *p. 116*

BURNERS
—Oil
Anthony Co., Long Island City, N.Y.
Best, Inc., W. N., New York, N.Y.
De La Vergne Machine Co., New York, N.Y.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Gwynn Gas Burner & Engineering Co., Pittsburgh, Pa.
Kenworthy, Charles F., Waterbury, Conn.
MacLeod Co., Cincinnati, O.
National Supply Co., Chicago, Ill.
Rockwell Co., W. S., New York, N.Y.
Spray Engineering Co., Boston, Mass.
Tate-Jones & Co., Inc., Pittsburgh, Pa.

CALENDERS
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 129*

CALENDER ROLL GRINDERS
(See Grinding Machinery)

CALORIMETERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Emerson Apparatus Co., Boston, Mass.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.

CANS, DYE HOUSE
Diamond State Fibre Co., Bridgeport, Pa.
Hill, James, Mfg. Co., Providence, R.I.
Standard Fibre Co., Somerville, Mass.

CANS, ROVING
American Vulcanized Fibre Co., Boston, Mass.
Cronkite Co., The, Boston, Mass.
Diamond State Fibre Co., Bridgeport, Pa.
Fibre Specialty Mfg. Co., Kennett Square, Pa.
Hill, James, Mfg. Co., Providence, R.I.
National Veneer Products Co., Mishawaka, Ind. *p. 149*
Rogers Fibre Co., Boston, Mass.
Standard Fibre Co., Somerville, Mass.

CARBONIZING MACHINERY
Phila. Drying Machinery Co., Philadelphia, Pa.
Phila. Textile Machinery Co., Philadelphia, Pa. *p. 124*
Sargent's Sons Corp., C. G., Graniteville, Mass.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*
Tolhurst Machine Works, Troy, N.Y. *p. 126*

CARD CLOTHING
American Card Clothing Co., Worcester, Mass.
Ashworth Bros., Fall River, Mass. *p. 119*
Atkinson, Haserick & Co., Boston, Mass.
Buhlmann, A. W., New York, N.Y.
Crabb, Wm., & Co., Newark, N.J.
Firth, Wm., Boston, Mass. *p. 107*
Howard Bros. Mfg. Co., Worcester, Mass. *p. 120*
Leigh & Butler, Boston, Mass. *p. 108*

CARD GRINDERS
(See Grinding Machinery)

CARD MACHINERY
Jacquard
Royle & Sons, John, Paterson, N.J. *p. 127*

CARDING MACHINERY
H. & B. American Machine Co., Pawtucket, R.I. *p. 105*
Mason Machine Works, Taunton, Mass. *p. 106*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Whitin Machine Works, Whitinsville, Mass. *p. 103*
Woonsocket Machine & Press Co., Woonsocket, R.I.

CARS
—Industrial Railway
Atlas Car & Mfg. Co., Cleveland, O.
Chase Foundry & Mfg. Co., Columbus, O.
Chattanooga Car & Foundry Co., Chattanooga, Tenn.
Eastern Car & Construction Co., Easton, Pa.
Hunt Co., Inc., C. W., West New Brighton, N.Y.
Link-Belt Co., Chicago, Ill.
Stuebner Iron Works, G. L., Long Island City, N.Y.
Youngstown Steel Car Co., Youngstown, O.

CEMENT
—Belt
Alexander Bros., Philadelphia, Pa.
Boston Belting Co., Boston, Mass.
Bradford Belting Co., Cincinnati, O.
Graton & Knight Manufacturing Co., The, Worcester, Mass. *p. 150*
Holyoke Belting Co., Holyoke, Mass.
Jewell Belting Co., Hartford, Conn.
Lawrence Belting Co., New York, N.Y.
Moloney Belting Co., Chicago, Ill.

CHAIN BELTS AND DRIVES
Abell-Howe Co. Chicago, Ill.
Link-Belt Company, Chicago, Ill.
Morse Chain Co., Ithaca, N.Y. *pp. 152-3*

CHEMICALS
(See Dyestuffs and Chemicals)

CHLORINE, LIQUID
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 134*

CIRCUIT BREAKERS
Condit Electrical Mfg. Co., South Boston, Mass.
General Electric Co., Schenectady, N.Y. *p. 161*
Roller-Smith Co., New York, N.Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*

CLUTCHES
—Friction
American Tool & Machine Co., Boston, Mass.
Brown Co., A. & F., New York, N.Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hill Clutch Co., Cleveland, O.
Johnson Machine Co., Carlyle, Manchester, Conn.
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
Medart Patent Pulley Co., St. Louis, Mo.
Weller Mfg. Co., Chicago, Ill.
Wellman-Seaver-Morgan Co., Cleveland, O.
Wood's Sons Co., T. B., Chambersburg, Pa.

COAL AND ASH HANDLING MACHINERY
American Steam Conveyor Corp'n, Chicago, Ill.
Brown Portable Conveying Machinery Co., Chicago, Ill.
Caldwell & Son Co., H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Hunt Co., Inc., C. W., West New Brighton, N.Y.
Industrial Workers, Bay City, Mich.
Jeffrey Mfg. Co., The, Columbus, O.
Lidgerwood Mfg. Co., New York, N.Y.
Link-Belt Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

COILS, PIPE
Cox Engineering & Tube Bending Machine Works, Bayonne, N.J.
Crane Co., Chicago, Ill.
National Pipe Bending Co., The, New Haven, Conn.
Pipe Coiling, Bending & Welding Co., Pittsburgh, Pa.
Simmons Co., John, New York, N.Y.

COLORS
(See Dyestuffs and Chemicals, Paints)

COMBERS
Atkinson, Haserick & Co., Boston, Mass.
Entwistle Co., T. C., Lowell, Mass.
Hood Co., R. H., Philadelphia, Pa.
Jefferson, Edward, Philadelphia, Pa.
Leigh & Butler, Boston, Mass. *p. 108*
Loom Reed & Harness Co., The, Charlotte, N.C.
Whitin Machine Works, Whitinsville, Mass. *p. 103*

COMBUSTION (CO.) RECORDERS
Combustion Appliances Co., Chicago, Ill.
Precision Instrument Co., Detroit, Mich.
Uehling Instrument Co., New York, N.Y.

COMPOUNDS
—Boiler
Binghamton Boiler Compound Co., Binghamton, N.Y.
Bird-Archer Co., New York, N.Y.
Dearborn Chemical Co., Chicago, Ill.
Engineering Supply Co., Philadelphia, Pa.
Harris Oil Co., A. W., Providence, R.I. *p. 142*
International Boiler Compound Co., Chicago, Ill.
North American Chemical & Engineering Co., New York, N.Y.
Paige & Jones Chemical Co., Inc., New York, N.Y.
Perolin Co. of America, Chicago, Ill.
Shawmut Chemical Co., Boston, Mass.

COMPRESSORS
—Air
American Steam Pump Co., Battle Creek, Mich.
Bury Compressor Co., Erie, Pa.
Chicago, Pneumatic Tool Co., Chicago, Ill.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Hooven, Owens, Rentschler Co., Hamilton, O.
Ingersoll-Rand Co., New York, N.Y.
Nordberg Mfg. Co., Milwaukee, Wis.
Norwalk Iron Works Co., So. Norwalk, Conn.
Sullivan Machinery Co., Chicago, Ill.
Vilter Mfg. Co., Milwaukee, Wis
Worthington Pump & Machinery Corp'n, New York, N.Y.

CONCRETE CONSTRUCTION
(See Contractors)

CONDENSERS
Alberger Pump & Condenser Co., New York, N.Y.
Baragwanath & Son, Wm., Chicago, Ill.
Blake Pump & Condenser Co., Fitchburg, Mass.
Davidson Co., M. T., New York, N.Y.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
Epping-Carpenter Pump Co., Pittsburgh, Pa.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
Schutte & Koerting Co., Philadelphia, Pa.
Wheeler Condenser & Engineering Co., Carteret, N.J.
Wheeler Mfg. Co., Philadelphia, Pa.
Wood & Co., R. D., Philadelphia, Pa.
Worthington Pump & Machinery Corp'n, New York, N.Y.

CONERS AND WINDERS
Foster Machine Co., Westfield, Mass. *p. 117*
Keystone Winding & Twisting Co., Philadelphia, Pa.
LeBon Bleach & Dye Works, Pawtucket, R.I.
Scientific Textile Co., Morrisville, Pa.
Textile Service Company, Philadelphia, Pa.

CONES AND TUBES, PAPER
Alpha Cone Co., Philadelphia, Pa.
Consolidated Paper Tube Co., Philadelphia, Pa.
National Paper Tube Co., Philadelphia, Pa.
Pairpoint Corporation, New Bedford, Mass.
Philadelphia Cone Co., Philadelphia, Pa.
Sinclair Cone Co., Norristown, Pa.
Universal Winding Co., Providence, R.I. *p. 118*

CONTRACTORS
Building
Aberthaw Construction Co., Boston, Mass. *p. 177*
Austin Co., The, Cleveland, O.
Crowell-Lundoff-Little Co., The, Cleveland, O.
Ferguson Co., John W., Paterson, N.J. *p. 178*
Ferro Concrete Construction Co., Cincinnati, O.
Flynt Building Construction Co., Palmer, Mass. *p. 179*
Ford, Bacon & Davis, New York, N.Y.
Guarantee Construction Co., New York, N.Y. *p. 180*
Hennebique Construction Co., New York, N.Y.
Housing Co., The, Boston, Mass. *p. 181*
Kearns, W. F., Boston, Mass. *p. 182*
Ley & Co., Inc., Fred T., Springfield, Mass.
Stone & Webster Engineering Corp., Boston, Mass.
Turner Construction Co., New York, N.Y.
White & Co., Inc., J. G., New York, N.Y.

CONTROLLERS
—Electric
Cutler-Hammer Mfg. Co., Milwaukee, Wis.
Electric Controller & Mfg. Co., Cleveland, O.
Fort Wayne Engineering & Mfg. Co., Fort Wayne, Ind.
General Electric Co., Schenectady, N.Y.
Industrial Controller Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*

CONVEYING
—Cotton
Saco-Lowell Shops, Boston, Mass. *p. 101*
Sturtevant Co., B. F., Boston, Mass.
Whitin Machine Works, Whitinsville, Mass. *p. 103*

CONVEYING MACHINERY
American Conveyor Co., Chicago, Ill.
Alvey Mfg. Co., St. Louis, Mo.
Barber-Greene Co., Aurora, Ill.
Caldwell & Son Co., H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N.Y.
Hill Clutch Co., Cleveland, O.
Hunt Co., Inc., C. W., West Brighton, N.Y.
Jones Foundry & Machine Co., Chicago, Ill.
Lamson Co., The, Boston, Mass.
Link-Belt Co., Chicago, Ill.
Mathews Gravity Carrier Co., Ellwood City, Pa.
Robins Conveying Belt Co., New York, N.Y.
Weller Mfg. Co., Chicago, Ill.
Wilcox Engineering Co., Saginaw, Mich.

COOLING TOWERS (Natural and Forced Draft)
Cooling Tower Co., New York, N.Y.
Seymour, Jr., J. M., Newark, N.J.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
Wheeler Condenser & Engineering Co., Carteret, N.J.
Wheeler Co., C. H., No. Philadelphia, Pa.
Worthington Pump & Machinery Corp'n, New York, N.Y.

COP TUBES
(See Cones)

COPPER PRINTING ROLLERS
Taunton-New Bedford Copper Co., New Bedford, Mass.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*

COPPERSMITHS
Badger & Sons Co., E. B., Boston, Mass.
Butterworth, H. W. & Sons Co., Philadelphia, Pa. *p. 129*
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*

COTTON MACHINERY
Ashworth Bros., Fall River, Mass. *p. 119*
Atkinson, Haserick & Co., Boston, Mass.
Barber-Colman Co., Rockford, Ill. *p. 122*
Butterworth, H. W., & Sons Co., Philadelphia, Pa. *p. 129*
Crompton & Knowles Loom Wks., Worcester, Mass. *p. 102*
Curtis & Marble Machine Co., Worcester, Mass. *p. 109*
Dixon Lubricating Saddle Co., Bristol, R.I.
Draper Corporation, Hopedale, Mass.
Easton & Burnham Machine Co., Pawtucket, R.I.
Elliott & Hall, Worcester, Mass.
Entwistle Co., T. C., Lowell, Mass.
Firth, Wm., Boston, Mass. *p. 107*
H. & B. American Machine Co., Pawtucket, R.I. *p. 105*
Houghton, L. T., Worcester, Mass.
Lever Co., Inc., Oswald, Philadelphia, Pa.
Leyland & Co., Thos., Readville, Mass.
Mason Machine Works, Taunton, Mass. *p. 106*
Metallic Drawing Roll Co., The, Indian Orchard, Mass.
Parks & Woolson Machine Co., Springfield, Vt. *p. 110*
Phila. Drying Machinery Co., Philadelphia, Pa.
Phila. Textile Machinery Co., Philadelphia, Pa. *p. 124*
Roy & Son Co., B. S., Worcester, Mass.
Saco-Lowell Shops, Boston, Mass. *p. 101*
Sargent's Sons Corp., C. G., Graniteville, Mass.
Smith & Furbush Machine Co., Philadelphia, Pa. *p. 121*
Stafford Co., The, Readville, Mass. *p. 104*
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*
Universal Winding Co., Boston, Mass. *p. 118*
Warp Compressing Machine Co., Worcester, Mass. *p. 111*
Whitin Machine Works, Whitinsville, Mass. *p. 103*
Whitinsville Spinning Ring Co., Whitinsville, Mass. *p. 115*
Woonsocket Mach. & Press Co., Woonsocket, R.I.

COUNTERS
—Revolution
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Durant Mfg. Co., Milwaukee, Wis.
Lonergan Co., J. E., Philadelphia, Pa.
Root & Co., C. J., Bristol, Conn.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Veeder Mfg. Co., Hartford, Conn.

COUNTERSHAFTS
American Tool & Machine Co., Boston, Mass.
Caldwell & Son Co., H. W., Chicago, Ill.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Hill Clutch Co., Cleveland, O.
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.
Wood's Sons Co., T. B., Chambersburg, Pa.

COUNTING MACHINES
Durant Manufacturing Co., Milwaukee, Wis.
National Scale Co., Chicopee Falls, Mass.
Root, C. J., & Co., Bristol, Conn.
Veeder Mfg. Co., Hartford, Conn.

COUPLINGS
—Shaft
American Tool & Machine Co., Boston, Mass.
Bond Co., Charles, Philadelphia, Pa.
Brown Co., A. & F., New York, N.Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hill Clutch Co., Cleveland, O.
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
Medart Patent Pulley Co., St. Louis, Mo.
Royersford Foundry & Machine Co., Philadelphia, Pa.
Weller Mfg. Co., Chicago, Ill.
Wood's Sons Co., T. B., Chambersburg, Pa.

COVERINGS
—Steam Pipe
American District Steam Co., No. Tonawanda, N.Y.
Carey Co., Philip, Cincinnati, O.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Fibre Cell Asbestos Mfg. Co., Chicago, Ill.
Franklin Mfg. Co., Franklin, Pa.
Johns-Manville Co., H. W., New York, N.Y.
Keasbey Co., Robert A., Ambler, Pa.
Magnesia Association of America, Philadelphia, Pa.
National Air Cell Covering Co., Jersey City, N.J.
Nightingale & Childs Co., Boston, Mass.
Standard Asbestos Mfg. Co., Chicago, Ill.
Wyckoff & Son Co., A., Elmira, N.Y.

CRAYONS
American Crayon Co., Waltham, Mass.
Binney & Smith Co., New York, N.Y.
Dixon Crucible Co., Jos., Jersey City, N.J.
Howe Mill Crayon Co., Lowell, Mass.
Lowell Crayon Co., Lowell, Mass.

CREELS
Warp Compressing Machine Co., Worcester, Mass. *p. 111*

CUTTING MACHINES, CLOTH
Cameron Machine Co., Brooklyn, N.Y.
Eastman Machine Co., Buffalo, N.Y.
Grand Rapids Tex. Machy. Co., Grand Rapids, Mich.
Ireland Mach. & Fdry. Co., Norwich, N.Y.
Metropolitan Sewing Mach. Co., Nyack, N.Y.

DAMPENERS
American Moistening Co., Boston, Mass. *p. 154*

DEXTRINE
Arnold, Hoffman & Co., Inc., Boston, Mass. *p. 134*
Nicol, J. M. & J. S., North Paterson, N.J.
Stein, Hirsh & Co., New York, N.Y.
Tanner & Co., Charles, Providence, R.I.

DOBBIES
Crompton & Knowles Loom Wks., Worcester, Mass. *p. 102*
Halton's Sons, Thomas, Philadelphia, Pa.
Mason Machine Works, Taunton, Mass. *p. 106*
Stafford Co., The, Readville, Mass. *p. 104*

DOUBLING AND ROLLING MACHINES
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 129*
Curtis & Marble Machine Co., Worcester, Mass. *p. 109*
Foster Machine Co., Westfield, Mass. *p. 117*
Parks & Woolson Machine Co., Springfield, Vt. *p. 110*
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*

DRAWING FRAMES
H. & B. American Machine Co., Pawtucket, R.I. *p. 105*
Mason Machine Works, Taunton, Mass. *p. 106*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Whitin Machine Works, Whitinsville, Mass. *p. 103*
Woonsocket Machine & Press Co., Woonsocket, R.I.

DRYING MACHINERY
(See also Dyeing, Drying, Bleaching and Finishing Machinery)
American Blower Co., Detroit, Mich.
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 129*
Drying Systems, Inc., Chicago, Ill.
New York Blower Co., Chicago, Ill.
Philadelphia Drying Machinery Co., Philadelphia, Pa.
Philadelphia Textile Machinery Co., Philadelphia, Pa. *p. 124*
Sturtevant Co., B. F., Boston, Mass.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*

DUST COLLECTORS
Buffalo Forge Co., Buffalo, N.Y. *p. 155*
Buffalo Steam Pump Co., Buffalo, N.Y.
Firth, Wm., Boston, Mass. *p. 107*
Phila. Drying Machinery Co., Philadelphia, Pa.
Sturtevant, B. F., Co., Hyde Park, Boston, Mass.

DYE BASES
du Pont de Nemours & Co., E. I., Wilmington, Del. *p. 133*

DYEING, DRYING, BLEACHING AND FINISHING MACHINERY
American Laundry Machinery Co., Cincinnati, O.
American Tool & Machine Co., Boston, Mass.
Frank Bailey, Camden, N.J.
Buffalo Forge Co., Buffalo, N.Y. *p. 155*
Butterworth, H. W., & Sons Co., Philadelphia, Pa. *p. 129*
Cocker Machine & Foundry Co., Gastonia, N.C.
Curtis & Marble Machine Co., Worcester, Mass. *p. 109*
Delahunty Dyeing Machine Co., Pittston, Pa. *p. 125*
Electro Chemical Co., Dayton, O.
Elliott & Hall, Worcester, Mass.
Franklin Process Co., Providence, R.I.
Hunt Machine Co., Rodney, Orange, Mass. *p. 147*
Hussong Dyeing Machine Co., Groveville, N.J.
Kenyon & Son, D. R., Raritan, N.J.
Klauder-Weldon Dyeing Mach. Co., Yardley, Pa.
Leigh & Butler, Boston, Mass. *p. 108*
Paramount Hos'y Form Dry'g Co., Chicago, Ill.
Parks & Woolson Machine Co., Springfield, Vt. *p. 110*
Perkins & Son, Inc., B. F., Holyoke, Mass.
Phila. Drying Machinery Co., Philadelphia, Pa.
Phila. Textile Machinery Co., Philadelphia, Pa. *p. 124*
Reliance Machine Works, Philadelphia, Pa.
Roy & Son Co., B. S., Worcester, Mass.
Salem Iron Works, Winston-Salem, N.C.
Sargent's Sons Corp., C. G., Graniteville, Mass.
Smith, Drum & Co., Philadelphia, Pa.
Sturtevant Co., B. F., Boston, Mass.
Suter, Alfred, New York, N.Y.
Tait, G. W., Providence, R.I.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*
Tolhurst Machine Works, Troy, N.Y. *p. 126*

DYE KETTLES
Allen Sons Co., Wm., Worcester, Mass.
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 129*
Delahunty Dyeing Machine Co., Pittston, Pa. *p. 125*
Hunt Machine Co., Rodney, Orange, Mass. *p. 147*
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*

DYE STICKS
Bailey, Frank, Cedar Brook, N.J.
Klauder-Weldon Dyeing Machine Co., Yardley, Pa.
Philadelphia Drying Machinery Co., Philadelphia, Pa.

DYESTUFFS AND CHEMICALS
Adelphia Dye & Chemical Co., Philadelphia, Pa.
American Aniline Products, Inc., New York, N.Y.
American Dyewood Co., Boston, Mass.
Arabol Mfg. Co., New York, N.Y.
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 134*
Bayer Co., Inc., The, New York, N.Y.
Bosson & Lane, Atlantic, Mass.
Cassella Color Co., New York, N.Y.
Chemical Co. of America, Inc., New York, N.Y.
Cronkhite Co., The Leonard W., Boston, Mass.
du Pont de Nemours & Co., E. I., Wilmington, Del. *p. 133*
Gibson, F. Swift, Philadelphia, Pa.
Klipstein & Co., A., New York, N.Y.
National Oil Products Co., Harrison, N.J.
Roessler & Hasslacher Chemical Co., New York, N.Y.
Saxe Chemical Co., New York, N.Y.
Sterling Color Co., Inc., New York, N.Y.
Wolf & Co., Jacques, Passaic, N.J.

ECONOMIZERS, FUEL
Green Fuel Economizer Co., New York, N.Y. *p. 169*
Sturtevant Co., B. F., Boston, Mass.

EJECTORS
American Injector Co., Detroit, Mich.
Hancock Inspirator Co., New York, N.Y.
Hayden & Derby Mfg. Co., New York, N.Y.
Penberthy Injector Co., Detroit, Mich.

ELEVATORS
—Passenger and Freight
Albro-Clem Elevator Co., Philadelphia, Pa.
American Elevator & Machine Co., Louisville, Ky.
Gurney Elevator Co., New York, N.Y.
McLauthlin Co., Geo. T., Boston, Mass.
Mason Co., Inc., Volney W., Providence, R.I.
Moore & Wyman Elevator & Machine Works, Boston, Mass.
Otis Elevator Co., New York, N.Y.
Ridgway & Son Co., Craig, Coatesville, Pa.
Standard Electric & Elev. Co., Baltimore, Md.
Standard Plunger Elevator Co., Worcester, Mass.
Wetherill & Co., Inc., Robt., Chester, Pa.
Wheeler-McDowell Elevator Co., New York, N.Y.

—Portable
Economy Engineering Co., Chicago, Ill.
N. Y. Revolving Portable Elevator Co., Jersey City, N.J.

ENGINEERS
—Consulting
(See also Engineers, Industrial)
Archer and Associates, W. G., New York, N.Y.
Cary, Albert A., New York, N.Y.
Emerson Company, New York, N.Y.
Estes, Incorporated, L. V., Chicago, Ill.
Fish, Charles H., Boston, Mass.
Fletcher-Thompson, Inc., Bridgeport, Conn.
French & Hubbard, Boston, Mass.
Green Co., Samuel M., Springfield, Mass.
Hooper-Falkenau Engineering Co., New York, N.Y.
Jackson, D. C. & Wm. B., Boston, Mass.
Little, Inc., Arthur D., Boston, Mass.
Main, Charles T., Boston, Mass. *p. 184*
Meyer, Jr., Henry C., New York, N.Y.
Moore, Frederick C., Cleveland, O.
Sanderson & Porter, New York, N.Y.
Suter, Alfred, New York, N.Y.
Thompson & Lichtner, Boston, Mass.
Westinghouse Church Kerr & Co., New York, N.Y.
Woodwell, J. E., New York, N.Y.

ENGINEERS
—Industrial
Allen & Co., A. M., Cleveland, O.
Arnold Company, The, New York, N.Y.
Chase, Frank D., Chicago, Ill.
Baker, Sutton & Harrison, New York, N.Y.
Day & Zimmenson, Philadelphia, Pa.
Dean, Inc., Francis W., Boston, Mass.
DeWolf & Co., John O., Boston, Mass.
Dyer, W. E. S., Philadelphia, Pa.
Fletcher, Thompson, Inc., Bridgeport, Conn.
Ford, Bacon & Davis, New York, N.Y.
French & Hubbard, Boston, Mass.
Gardner & Lindberg, Chicago, Ill.
Gray, Arthur F., Boston, Mass.
Green Company, Samuel M., Springfield, Mass.
Hooper-Falkenau Engineering Co., New York, N.Y.
Kimball, Herbert S., Boston, Mass.
Knoeppel & Co., C. E., New York, N.Y.
Lockwood, Greene & Co., Boston, Mass. *p. 183*
Main, Charles T., Boston, Mass. *p. 184*
Marvell, Edward L., Fall River, Mass.
Makepeace, C. R., Providence, R.I.
Monks & Johnson, Boston, Mass.
Peuckert & Wunder, Philadelphia, Pa.
Prather, H. B., Cleveland, O.
Scofield Engineering Company, Philadelphia, Pa.
Seabury, Dwight, Pawtucket, R.I.
Sellers, Philip, New Haven, Conn.
Sheldon Co., F. P., Providence, R.I.
Sirrine, J. E., Greenville, S.C.
Stevens, John A., Lowell, Mass.
Stone & Webster Engineering Corp., Boston, Mass.
Suck, Adolph, Hyde Park, Mass.
Watson Engineering Co., Cleveland, O.
Westinghouse Church Kerr Co., New York, N.Y.
White & Co., Inc., J. C., New York, N.Y.
Woodmansee-Davidson Engrg. Co., Chicago, Ill.

ENGINES
—Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ball Engine Co., Erie, Pa.
Bass Foundry & Machine Co., Fort Wayne, Ind.
Brown Engine Co., Fitchburg, Mass.
Erie City Iron Works, Erie, Pa.
Fitchburg Steam Engine Co., Fitchburg, Mass.
Fulton Iron Works Co., St. Louis, Mo.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Harrisburg Foundry & Machine Works, Harrisburg, Pa.
Harris-Corliss Engine & Machine Co., Providence, R.I.
Hewes & Phillips Iron Works, Newark, N.J.
Hooven, Owens, Rentschler Co., Hamilton, O.
Houston, Stanwood & Gamble Co., Cincinnati, O.
Ide & Sons, A. L., Springfield, Ill.
Lane & Bodley Co., Cincinnati, O.
Mesta Machine Co., Pittsburgh, Pa.
Murray Iron Works Co., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee, Wis.
Providence Engineering Corp'n, Providence, R.I.
Reeves-Cubberly Engine Co., Trenton, N.J.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Rollins Engine Co., Nashua, N.H.
Skinner Engine Co., Erie, Pa.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
Sturtevant Co., B. F., Boston, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*
Wetherill & Co., Inc., Robt., Chester, Pa.

EXHAUST HEADS
Burt Mfg. Co., Akron, O.
Direct Separator Co., Syracuse, N.Y.
Hoppes Mfg. Co., The, Springfield, O.
Massachusetts Blower Co., Watertown, Mass. *p. 160*
Ohio Blower Co., Cleveland, O.
Patterson & Co., Frank L., New York, N.Y.
Pittsburgh Valve, Foundry & Const. Co., Pittsburgh, Pa.
Sturtevant Co., B. F., Boston, Mass.

EXPANDERS, CLOTH
Leyland, Thos. & Co., Readville, Mass.

EXPANSION JOINTS
Alberger Pump & Condenser Co., New York, N.Y.
Badger & Sons, E. B., Boston, Mass.
Tyler Underground Heating System, Pittsburgh, Pa.

EXTRACTORS, HYDRO-
(See Hydro-Extractors)

EXTRACTS
(See Dyestuffs & Chemicals)

FANS, EXHAUST
American Blower Co., Detroit, Mich.
Barney Ventilating Fan Works, Boston, Mass.
Buffalo Forge Co., Buffalo, N.Y. *p. 155*
Dixie Mfg. Co., Inc., Baltimore, Md.
Garden City Fan Co., Chicago, Ill.
Green Fuel Economizer Co., New York, N.Y. *p. 169*
Howard & Morse, New York, N.Y.
Indiana Fan Co., Indianapolis, Ind.
Massachusetts Blower Co., Watertown, Mass. *p. 160*
National Blow Pipe & Mfg. Co., Ltd., New Orleans, La.
Perkins & Son, B. F., Holyoke, Mass.
Philadelphia Drying Machinery Co., Philadelphia, Pa.
Sterling Blower Co., Hartford, Conn.
Sturtevant Co., B. F., Boston, Mass.
Tolhurst Machine Works, Troy, N.Y. *p. 126*

FEEDS, AUTOMATIC
Curtis & Marble Mach. Co., Worcester, Mass. *p. 109*
Phila. Drying Machinery Co., Philadelphia, Pa.
Phila. Textile Machinery Co., Philadelphia, Pa. *p. 124*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Sargent's Sons Corp., C. G., Graniteville, Mass.
Schofield, Wm., Co., Manayunk, Philadelphia, Pa.
Smith & Furbush Machine Co., Philadelphia, Pa. *p. 121*
Tatham, William, Ltd., Rochdale, England (Wm. Firth, Agent)
Woonsocket Mach. & Press Co., Woonsocket, R.I.

FENCES, WIRE (IRON)
Anchor Post Iron Works, New York, N.Y.
Cyclone Fence Co., Waukegan, Ill.
Enterprise Iron Works, Indianapolis, Ind.
Page Steel & Wire Co., Adrian, Mich.
Stewart Iron Works Co., Covington, Ky.
Wright Wire Co., Worcester, Mass.

FILTERS
—Water
American Water Softener Co., Philadelphia, Pa.
Beggs & Co., James, New York, N.Y.
Casey-Hedges Co., Chattanooga, Tenn.
Harrison Safety Boiler Works, Philadelphia, Pa.
Hungerford & Terry, Inc., Philadelphia, Pa.
Hygeia Filter Co., Detroit, Mich.
International Filter Co., Chicago, Ill.
Leigh & Butler, Boston, Mass. *p. 108*
Loomis-Manning Filter Distributing Co., Philadelphia, Pa.
New York Continental Jewell Filtration Co., New York, N.Y.
Permutit Co., New York, N.Y.
Pittsburgh Filter Mfg. Co., Pittsburgh, Pa.
Roberts Filter Mfg. Co., Darby, Pa.

Scaife & Sons Co., Wm. B., Pittsburgh, Pa. *p. 175*
Starkweather & Broadhurst, Boston, Mass. *p. 173*

FINISHING MACHINERY
(See also Dyeing, Drying, Bleaching and Finishing)
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 129*
Philadelphia Drying Machinery Co., Philadelphia, Pa.
Philadelphia Textile Machinery Co., Philadelphia, Pa. *p. 124*
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*

FIRE DOOR FIXTURES (Automatic)
Automatic Sprinkler Co. of America, New York, N.Y.
Coburn Trolley Track Mfg. Co., Holyoke, Mass.
Richards-Wilcox Mfg. Co., Aurora, Ill.
Stowell Co., So. Milwaukee, Wis.

FIRE EXTINGUISHERS
American-La France Fire Engine Co., Inc., Elmira, N.Y.
Automatic Sprinkler Co. of America, New York, N.Y.
Johns-Manville Co., H. W., New York, N.Y.
Montgomery & Co., Inc., New York, N.Y.

FLYERS
Bodden, Wm., & Son, Ltd., Providence, R.I.
Firth, William, Boston, Mass. *p. 107*
H. & B. American Machine Co., Pawtucket, R.I. *p. 105*
Southern Spindle & Flyer Co., Charlotte, N.C. *p. 112*

FOLDING MACHINERY
Curtis & Marble Machine Co., Worcester, Mass. *p. 109*

FRAMES, UNIVERSAL
Steel Heddle Mfg. Co., Philadelphia, Pa.

FUEL ECONOMIZERS
(See Economizers, Fuel)

FUSES
D & W Fuse Co., Providence, R.I.
Detroit Fuse & Mfg. Co., Detroit, Mich.
Economy Fuse & Mfg. Co., Chicago, Ill. *p. 161*
General Electric Co., Schenectady, N.Y.
Johns-Manville Co., H. W., New York, N.Y.
Johns-Pratt Co., Hartford, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*

FUSTIC
Kuttroff, Pickhardt & Co., Inc., New York, N.Y. *p. 130*
National Aniline & Chemical Co., New York, N.Y. *p. 131*

GARNET GRINDERS
(See Grinding Machinery)

GASKETS
(See Packing)

GASSING MACHINES
(See Singeing Machines)

GAUGE GLASSES
Ashton Valve Co., Cambridge, Mass.
Chesterton Co., A. W., Boston, Mass.
Crane Co., Chicago, Ill.
Durable Mfg. Co., New York, N.Y.
Magee Valve Co., Inc., New York, N.Y.

GAUGES
—Pressure
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Ashcroft Mfg. Co., New York, N.Y.
Ashton Valve Co., Cambridge, Mass.
Bacharach Industrial Instrument Co., Pittsburgh, Pa.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Crosby Steam Gage & Valve Co., Boston, Mass.
Foxboro Co., Foxboro, Mass.
Lonergan Co., J. E., Philadelphia, Pa.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
Precision Instrument Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Star Brass Mfg. Co., Boston, Mass.
Tagliabue Mfg. Co., C. J., Brooklyn, N.Y.
Uehling Instrument Co., New York, N.Y.
United States Gauge Co., New York, N.Y.

GENERATING SETS
American Blower Co., Detroit, Mich.
General Electric Co., Schenectady, N.Y. *p. 161*
Ide & Sons, A. L., Springfield, Ill.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
Sturtevant Co., B. F., Boston, Mass.
Terry Steam Turbine Co., Hartford, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*

GENERATORS
—Electric
C & C Electric & Mfg. Co., Garwood, N.J.
Crocker-Wheeler Co., Ampere, N.J.
De Laval Steam Turbine Co., Trenton, N.J. *p. 166*
Emerson Electric Mfg. Co., St. Louis, Mo.
General Electric Co., Schenectady, N.Y. *p. 161*
Reliance Electric & Eng. Co., Cleveland, O.
Robbins & Myers Co., Springfield, O.
Sprague Electric Works, New York, N.Y.
Sturtevant Co., B. F., Boston, Mass.
Western Electric Co., Inc., New York, N.Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*

GIGS
Curtis & Marble Machine Co., Worcester, Mass. *p. 109*
Hunt Machine Co., Rodney, Orange, Mass. *p. 147*
Parks & Woolson Machine Co., Springfield, Vt. *p. 110*

GOVERNORS
—Engine and Pump
Fisher Governor Co., Marshalltown, Ia.
Ford Co., Thomas P., New York, N.Y. *p. 168*
Foster Engineering Co., Newark, N.J.
Gardner Governor Co., Quincy, Ill.
Houston, Stanwood & Gamble Co., Cincinnati, O.
Ideal Automatic Governor Co., Newark, N.J.
Northern Equipment Co., Erie, Pa.
Pickering Governor Co., Portland, Conn.
Richardson-Phenix Co., Milwaukee, Wis.
Waters Governor Co., Lawrence, Mass.

GRATES
—Shaking
Bass Foundry & Machine Co., Fort Wayne, Ind.
Casey-Hedges Co., Chattanooga, Tenn.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass. *p. 167*
International Engineering Works, Inc., Framingham, Mass. *p. 170*
Keeler Co., E., Williamsport, Pa.
McClave-Brooks Co., Scranton, Pa.
Marshall Foundry Co., Pittsburgh, Pa.
Martin Grate Co., Chicago, Ill.
New England Roller Grate Co., Springfield, Mass.
Shelvin Engineering Co., Inc., New York, N.Y.
Springfield Boiler Co., Springfield, Ill.
Wickes Boiler Co., The, Saginaw, Mich. *p. 172*

GREASE
Albany Lubricating Co., New York, N.Y.
Houghton & Co., E. F., Philadelphia, Pa.
Keystone Lubricating Co., Philadelphia, Pa.

New York & New Jersey Lubricant Co., New York, N.Y. p. 139
Philadelphia Grease Mfg. Co., Philadelphia, Pa.
Standard Oil Co. of New York, New York, N.Y.
Swan & Finch, New York, N.Y. p. 143
Texas Co., New York, N.Y. p. 140
Valvoline Oil Co., New York, N.Y.
Wolverine Lubricants Co. of N.Y., New York, N.Y.

GREASES
—Textile
Borne, Scrymser Co., New York, N.Y. p. 141
Brierly-Lombard Co., The, Worcester, Mass.
Jackson & Co., Ellis, Philadelphia, Pa.

GRINDING MACHINERY, CARD
Atkinson, Haserick & Co., Boston, Mass.
Entwistle, T. C., Co., Lowell, Mass.
Firth, Wm., Boston, Mass. p. 107
Hubbard Machine Co., Worcester, Mass.
Leigh & Butler, Boston, Mass. p. 108
Roy & Son Co., B. S., Worcester, Mass.
Smith & Furbush Machine Co., Philadelphia, Pa. p. 121

GUIDERS, CLOTH
Butterworth & Sons Co., H. W., Philadelphia, Pa. p. 129
Leyland, Thos. & Co., Readville, Mass.
Textile-Finishing Machinery Co., The, Providence, R.I. p. 114

GUMS
(See Sizing, Starch and Gums)

HANGERS
—Shaft
Bond Co., Charles, Philadelphia, Pa.
Brown Co., A. & F., New York, N.Y.
Chain Belt Co., Milwaukee, Wis.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hill Clutch Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Medart Patent Pulley Co., St. Louis, Mo.
Royersford Foundry & Machine Co., Philadelphia, Pa.
Weller Mfg. Co., Chicago, Ill.

HARNESSES
Crompton & Knowles Loom Wks., Worcester, Mass. p. 102
Emmons Loom Harness Co., Lawrence, Mass.
Garland Mfg. Co., Saco, Me.
Loom Reed & Harness Co., Charlotte, N.C.
Moore, C., & Co., Philadelphia, Pa.
Steel Heddle Mfg. Co., Philadelphia, Pa.

HEATERS
—Feed Water
Alberger Heater Co., Buffalo, N.Y.
Baragwanath & Son, Wm., Chicago, Ill.
Griscom Russell Co., New York, N.Y.
Houston, Stanwood & Gamble Co., Cincinnati, O.
Keeler Co., E., Williamsport, Pa.
National Pipe Bending Co., The, New Haven, Conn.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa. p. 175
Stewart Heater Co., Buffalo, N.Y.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn. p. 171
Whitlock Coil Pipe Co., Hartford, Conn.
Worthington Pump & Machinery Corp'n, New York, N.Y.

HEATERS AND PURIFIERS
—Feed Water
Elliott Co., Pittsburgh, Pa.
Griscom Russell Co., New York, N.Y.
Harrison Safety Boiler Works, Philadelphia, Pa.
Hoppes Mfg. Co., Springfield, O.
National Pipe Bending Co., The, New Haven, Conn.
Platt Iron Works, Dayton, O.
Starkweather & Broadhurst, Boston, Mass. p. 173
Stewart Heater Co., Buffalo, N.Y.
Webster & Co., Warren, Camden, N.J.

HEATING SYSTEMS
—Vacuum
Consolidated Engineering Co., Chicago, Ill.
Dunham Co., C. A., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Keeler Co., E., Williamsport, Pa.
Webster & Co., Warren, Camden, N.J.

HEATING AND VENTILATING APPARATUS
American Blower Co., Detroit, Mich.
American District Steam Co., N. Tonawanda, N.Y.
American Radiator Co., Chicago, Ill.
Buffalo Forge Co., Buffalo, N.Y. p. 155
Carrier Engineering Corp., New York, N.Y. pp. 156-7
Consolidated Engineering Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass. p. 160
Parks-Cramer Co., Fitchburg, Mass. pp. 158-9
Smith Co., H. B., Westfield, Mass.
Sturtevant Co., B. F., Boston, Mass.
Webster & Co., Warren, Camden, N.J.

HEDDLES AND FRAMES
Atkinson, Haserick & Co., Boston, Mass.
Firth, William, Boston, Mass. p. 107
Garland Mfg. Co., Saco, Me.
Gowdey Reed & Harness Mfg. Co., J. A., Providence, R.I.
Loom Reed & Harness Co., Charlotte, N.C.
Steel Heddle Mfg. Co., Philadelphia, Pa.
Walker Mfg. Co., Philadelphia, Pa.
Williams, J. H. Co., Chicago, Ill.

HOBBING MACHINES
Barber-Colman Co., Rockford, Ill. p. 122

HOBS
Barber-Colman Co., Rockford, Ill. p. 122

HOSE
—Rubber
Boston Belting Co., Boston, Mass.
Boston Woven Hose & Rubber Co., Cambridge, Mass.
Goodrich Co., B. F., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.
Gutta Percha & Rubber Mfg. Co., New York, N.Y.
Johns-Manville Co., H. W., New York, N.Y.
New York Belting & Packing Co., New York, N.Y.
New York Rubber Co., New York, N.Y.
Quaker City Rubber Co., Philadelphia, Pa.
Revere Rubber Co., Chelsea, Mass.

HUMIDIFIERS
American Blower Co., Detroit, Mich.
American Moistening Co., Boston, Mass. p. 154
Braemer Air Conditioning Corp'n, Philadelphia, Pa.
Carrier Air Conditioning Co., Buffalo, N.Y.
Carrier Engineering Corp'n, New York, N.Y. pp. 156-7
Normalair Co., Winston-Salem, N.C.
Parks-Cramer Co., Fitchburg, Mass. pp. 158-9
Tillotson Humidifier Co., Providence, R.I.

HYDRANTS, FIRE
Darling Pump & Mfg. Co., Ltd., Williamsport, Pa.
Eddy Valve Co., Waterford, N.Y.
Kennedy Valve Mfg. Co., Elmira, N.Y.

Ludlow Valve Mfg. Co., Troy, N.Y.
Norwood Engineering Co., Florence, Mass.
Pratt & Cady Co., Inc., Hartford, Conn.
Wood & Co., R. D., Philadelphia, Pa.
Worthington Pump & Machinery Corp'n, New York, N.Y.

HYDRO-EXTRACTORS
American Tool & Machine Co., Boston, Mass.
Atkinson, Haserick & Co., Boston, Mass.
Buhlmann, A. W., New York, N.Y.
Hunt Machine Co., Rodney, Orange, Mass. *p. 147*
Street and Co., R. R., Chicago, Ill.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*
Tolhurst Machine Works, Troy, N.Y. *p. 126*

INDICATORS
—Engine
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Crosby Steam Gage & Valve Co., Boston, Mass.
Powell Co., The Wm., Cincinnati, O.
Robertson & Sons, James L., New York, N.Y.
Thompson & Co., Richard, New York, N.Y.
Trill Indicator Co., Corry, Pa.

INDIGO
Cronkhite Co., The Leonard W., Boston, Mass.
Klipstein & Co., A., New York, N.Y.
Kuttroff, Pickhardt & Co., New York, N.Y. *p. 130*
National Aniline & Chemical Co., Inc., New York. *p. 131*
Zobel Company, Inc., Ernst, Brooklyn, N.Y.

INJECTORS
American Injector Co., Detroit, Mich.
Crane Co., Chicago, Ill.
Hancock Inspirator Co., New York, N.Y.
Jenkins Bros., New York, N.Y.
Nathan Mfg. Co., Flushing, N.Y.
Penberthy Injector Co., Detroit, Mich.

INSTRUMENTS
—Electrical Measuring
Biddle, James G., Philadelphia, Pa.
Brown Instrument Co., Philadelphia, Pa.
General Electric Co., Schenectady, N.Y. *p. 161*
Jewell Electrical Instrument Co., Chicago, Ill.
Leeds & Northrup Co., Philadelphia, Pa.
Pyrolectric Instrument Cos., Trenton, N.J.
Robert Instrument Co., Detroit, Mich.
Taylor Instrument Cos., Rochester, N.Y.
Thompson-Levering Co., Philadelphia, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*
Weston Electrical Instrument Co., Newark, N.J.

INSULATING MATERIALS
—Heat and Cold
Armstrong Cork & Insulation Co., Pittsburgh, Pa.
Booth Felt Co., Inc., Brooklyn, N.Y.
Celite Products Co., New York, N.Y.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Fibre Cell Asbestos Mfg. Co., Chicago, Ill.
Johns-Manville Co., H. W., New York, N.Y.
Keasbey & Mattison Co., Ambler, Pa.
Magnesia Association of America, Philadelphia, Pa.
Nightingale & Childs Co., Boston, Mass.
Standard Asbestos Mfg. Co., Chicago, Ill.
United States Mineral Wool Co., New York, N.Y.

INSURANCE, LIABILITY
American Mutual Liability Insurance Co., Boston, Mass. *p. 163*

INTERMEDIATES
Chemical Co. of America, Inc., New York, N.Y.
du Pont de Nemours & Co., E. I., Wilmington, Del. *p. 133*

JACQUARDS
Crompton & Knowles Loom Wks., Worcester, Mass. *p. 102*
Halton's, Thomas, Sons, Philadelphia, Pa.

KETTLES, STEAM JACKET
Butterworth, H. W., & Sons Co., Philadelphia, Pa. *p. 129*
Duriron Castings Co., New York, N.Y.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*

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KNITTING MACHINES
Scott & Williams, New York, N.Y. *p. 128*

KNOTTERS
Barber-Colman Co., Rockford, Ill. *p. 122*

LACERS
Royle & Sons, John, Paterson, N.J. *p. 127*

LAMPS
—Electric
Cooper Hewitt Electric Co., Hoboken, N.Y.
General Electric Co., Schenectady, N.Y. *p. 161*
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*
Westinghouse Lamp Co.
Whitelite Electric Company, New York, N.Y.

LEADERS
Barber Mfg. Co., Lowell, Mass.

LEATHERS
—Textile
Bond Co., Charles, Philadelphia, Pa.
Graton & Knight Mfg. Co., The, Worcester, Mass. *p. 145*
Schieren Co., Chas. A., New York, N.Y.

LIABILITY INSURANCE
American Mutual Liability Insurance Co., Boston, Mass. *p. 163*

LISTINGS
Barber Mfg. Co., Lowell, Mass.

LOCKERS
—Metal
Berger Mfg. Co., Canton, O.
Durand Steel Locker Co., Chicago, Ill.
Edwards Mfg. Co., Cincinnati, O.
Lupton's Sons Co., David, Philadelphia, Pa.
Manufacturing Equip. & Mfg. Co., Framingham, Mass.
Narragansett Machine Co., Providence, R.I.
Wright Wire Co., Worcester, Mass.

LOGWOOD
Kuttroff, Pickhardt & Co., New York, N.Y. *p. 130*
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LOOMS
Atkinson, Haserick & Co., Boston, Mass.
Crompton & Knowles Loom Wks., Worcester, Mass. *p. 102*
Draper Corporation, Hopedale, Mass.
Mason Machine Works, Taunton, Mass. *p. 106*
Saco-Lowell Shops, Boston, Mass. *p. 101*
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LOOM PICKERS
Garland Mfg. Co., Saco, Me.
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Albany Lubricating Co., New York, N.Y.
Borne, Scrymser Co., New York, N.Y. *p. 141*
Indian Refining Co., Inc., New York, N.Y.
Harris, H. W., Co., Providence, R.I. *p. 142*
Kellogg & Co., E. H., New York, N.Y.
Keystone Lubricating Co., Philadelphia, Pa.
McCord Mfg. Co., Inc., Detroit, Mich.
New York & New Jersey Lubricant Co., New York, N.Y. *p. 139*
Philadelphia Grease Mfg. Co., Philadelphia, Pa.
Richardson-Phenix Co., The, Milwaukee, Wis.
Robinson & Son Co., Wm. C., Baltimore, Md.
Standard Oil Co., Chicago, Ill.
Swan & Finch Co., New York, N.Y. *p. 143*
Texas Co., New York, N.Y. *p. 140*
Vacuum Oil Co., New York, N.Y.
White & Bagley Co., Worcester, Mass.

LUBRICATORS
—Force-Feed
Detroit Lubricator Co., Detroit, Mich.
Greene, Tweed & Co., New York, N.Y.
Inter-State Machine Products Co., Rochester, N.Y.
McCord Mfg. Co., Detroit, Mich.
Madison-Kipp Lubricator Co., Madison, Wis.
Richardson-Phenix Co., Milwaukee, Wis.

MEASURING AND FOLDING MACHINES
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Elliot & Hall, Worcester, Mass.
Jefferson, Edward, Philadelphia, Pa.
Parks & Woolson Machine Co., Springfield, Vt. *p. 110*
Root & Co., C. J., Bristol, Conn.
Smith, Wm., & Sons, Lawrence, Mass.
Street & Co., R. R., Chicago, Ill.
Windle, J. E., Worcester, Mass.

MECHANICAL DRAFT APPARATUS
American Blower Co., Detroit, Mich
Buffalo Forge Co., Buffalo, N.Y. *p. 155*
Coppus Engineering & Equipment Co., Worcester, Mass.
Engineer Co., The, New York, N.Y.
Green Fuel Economizer Co., New York, N.Y. *p. 169*
Sturtevant Co., B. F., Boston, Mass.

MERCERIZING MACHINERY
Buhlmann, A. W., New York, N.Y.
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 129*
Jefferson, Edward, Philadelphia, Pa.
Klauder-Weldon Dyeing Machine Co., Yardley, Pa.
Smith, Drum & Co., Philadelphia, Pa.
Standard Processing Co., Philadelphia, Pa.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*

METERS
Steam
American District Steam Co., No. Tonawanda, N.Y.
Bailey Meter Co., Boston, Mass. *p. 137*
Builders Iron Foundry, Providence, R.I.
General Electric Co., Schenectady, N.Y. *p. 161*
New Jersey Meter Co., Plainfield, N.J.
Republic Flow Meters Co., Chicago, Ill.
Sargent Steam Meter Co., Chicago, Ill.
Boston Belting Co., Boston, Mass.
Cancos Mfg. Co., Philadelphia, Pa.
Endura Mfg. Co., Philadelphia, Pa.
Garlock Packing Co., Palmyra, N.Y.
Goetze Gasket & Packing Co., New Brunswick, N.J.
Goodrich Co., B. F., Akron, O.
Hamilton Rubber Mfg. Co., Trenton, N.J.
Jenkins Bros., New York, N.Y.
Johns-Manville Co., H. W., New York, N.Y.
New York Belting & Packing Co., New York, N.Y.
New York Rubber Co., New York, N.Y.
Quaker City Rubber Co., Philadelphia, Pa.

PACKING LEATHER
Graton & Knight Mfg. Co., The, Worcester, Mass. *p. 150*

PAINTS AND VARNISHES
Arco Company, Cleveland, O.
Chaffee Co., Thos. K., Providence, R.I.
Chicago White Lead & Oil Co., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N.J.
Hampden Paint & Chemical Co., Springfield, Mass.
Harrison Works, Wilmington, Del. *p. 146*
Lowe Bros. Co., The, Dayton, O.
Patton Paint Co., Milwaukee, Wis.
Toch Brothers, New York, N.Y.
U. S. Gutta Percha Paint Co., Providence, R.I.
U. S. Varnish Co., New York, N.Y.
Wadsworth, Howland Co., Boston, Mass.

PAPER AND TWINE
Blauvelt-Wiley Paper Mfg. Co., New York, N.Y.
Consolidated Paper Tube Co., Philadelphia, Pa.
Greene Paper Co., R. L., Providence, R.I. *p. 148*
Kelley Co., Henry C., New York, N.Y.
Lane, Albert A., New York, N.Y.
Merwin Paper Co., The, Hartford, Conn.
O'Meara Co., Maurice, New York, N.Y.
Richardson Bros., New York, N.Y.

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Sargent's Sons Corp., C. G., Graniteville, Mass.
Smith & Furbush Machine Co., Philadelphia, Pa. *p. 121*

PICKERS, LEATHER
Foulds & Sons, Inc., Hudson, Mass.
Garland Mfg. Co., Saco, Me.
Graton & Knight Mfg. Co., The, Worcester, Mass. *p. 150*
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Dodge, C. S., Lowell, Mass.
Schofield, Wm., Co., Manayunk, Philadelphia, Pa.
Smith & Furbush Machine Co., Philadelphia, Pa. *p. 121*
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PICKING MACHINERY
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Saco-Lowell Shops, Boston, Mass. *p. 101*
Whitin Machine Works, Whitinsville, Mass. *p. 103*
Woonsocket Machine & Press Co., Woonsocket, R.I.

POWER TRANSMISSION MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Tool & Machine Co., Boston, Mass.
Baldwin Chain & Mfg. Co., Worcester, Mass. *p. 151*
Birmingham Iron Foundry, Derby, Conn.
Caldwell & Son Co., H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Cresson-Morris Co., Philadelphia, Pa.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hill Clutch Co., Cleveland, O.
Hunt Machine Co., Rodney, Orange, Mass.

Link-Belt Co., Chicago, Ill.
Lombard Iron Works & Supply Co., Augusta, Ga.
Morse Chain Co., Ithaca, N.Y. *pp. 152-3*
Poole Engineering & Machine Co., Baltimore, Md.
Royersford Foundry & Machine Co., Philadelphia, Pa.
Weller Mfg. Co., Chicago, Ill.
Wood's Sons Co., T. B., Chambersburg, Pa.

PREPARATORY MACHINERY
Jefferson, Edward, Philadelphia, Pa.
Leigh & Butler, Boston, Mass. *p. 108*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Smith & Furbush Machine Co., Philadelphia, Pa. *p. 121*

PRESSES
Alsteel Manufacturing Co., Battle Creek, Mich.
American Laundry Machinery Co., Cincinnati, O.
Boomer & Boschert Press Co., Syracuse, N.Y.
Buhlmann, A. W., New York, N.Y.
Butterworth, H. W. & Sons Co., Philadelphia, Pa. *p. 129*
Curtis & Marble Machine Co., Worcester, Mass. *p. 109*
Dodge, C. S., Lowell, Mass.
Lorimer, John H., Philadelphia, Pa.
Phila. Drying Machinery Co., Philadelphia, Pa.
Reliance Machine Works, Philadelphia, Pa.
Saco-Lowell Shops, Boston, Mass. *p. 101*
Smith & Furbush Mach. Co., Philadelphia, Pa. *p. 121*
Spence & Rideout, Nashua, N.H.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*
U. S. Hoffman Co., Syracuse, N.Y.

PRESSES (Baling)
Economy Baler Co., Ann Arbor, Mich.
Garrett & Co., Sylvester S., Philadelphia, Pa.
Klein Co., H. J., Louisville, Ky.
Sullivan Machinery Co., Chicago, Ill.

PRESS BOARDS AND PAPERS
Diamond State Fibre Co., Bridgeport, Pa.
Greene Paper Co., R. L., Providence, R.I.
Merwin Paper Co., Hartford, Conn.
Phila. Drying Machinery Co., Philadelphia, Pa.

PROSPECTING MACHINERY
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Parks & Woolson Machine Co., Springfield, Vt. *p. 110*

PULLEYS
—Iron
American Tool & Machine Co., Boston, Mass.
Brown Co., A. & F., New York, N.Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Cork Insert Co., Boston, Mass.
Dodge Sales & Engineering Co., Cuyahoga Falls, O.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hill Clutch Co., Cleveland, O.
Hunt Machine Co., Rodney, Orange, Mass. *p. 147*
Link-Belt Co., Chicago, Ill.
Medart Patent Pulley Co., St. Louis, Mo.
Poole Engineering & Machine Co., Baltimore, Md.
Standard Pulley Co., Cincinnati, O.
Weller Mfg. Co., Chicago, Ill.
Wood's Sons Co., T. C., Chambersburg, Pa.
—Wood
Caldwell & Son Co., H. W., Chicago, Ill.
Detroit Pulley Co., Detroit, Mich.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Eclipse Wood Pulley Co., Inc., Berlin, Pa.
Jones Foundry & Machine Co., W. A., Chicago, Ill.
Menasha Wood Split Pulley Co., Menasha, Wis.
Reading Wood Pulley Co., Reading, Pa.
Reeves Pulley Co., Columbus, Ind.
Weller Mfg. Co., Chicago, Ill.

PUMPS
Boiler Feed
American Steam Pump Co., Battle Creek, Mich.
Cameron Steam Pump Works, A. S., New York, N.Y.
Davidson Co., M. T., New York, N.Y.
Deming Co., Salem, O.
Douglas, W. & B., Middletown, Conn.
Epping-Carpenter Pump Co., Pittsburgh, Pa.
Hall Steam Pump Co., Pittsburgh, Pa.
International Steam Pump Co., New York, N.Y.
Morris Machine Works, Baldwinsville, N.Y.
Platt Iron Works, Dayton, O.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
Reilly Mfg. Co., J. J., Louisville, Ky.
Scranton Steam Pump Co., Scranton, Pa.
Worthington Pump & Machinery Corp'n, New York, N.Y.

— Centrifugal
Advance Pump & Compressor Co., Battle Creek, Mich.
Alberger Pump & Condenser Co., New York, N.Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Steam Pump Co., Battle Creek, Mich.
American Well Works, Aurora, Ill.
Bagley & Sewall Co., Watertown, N.Y.
Buffalo Steam Pump Co., Buffalo, N.Y.
Cameron Steam Pump Works, A. S., New York, N.Y.
Dayton Turbine Pump Co., Cleveland, O.
De Laval Steam Turbine Co., Trenton, N.J. *p. 166*
D'Olier Centrifugal Pump & Machine Co., Philadelphia, Pa.
Epping-Carpenter Pump Co., Pittsburgh, Pa.
Goulds Mfg. Co., Seneca Falls, N.Y.
Hunt, Rodney, Machine Co., Orange, Mass. *p. 147*
Kingsford Foundry & Machine Works, Oswego, N.Y.
Lawrence Pump & Engine Co., Lawrence, Mass.
Morris Machine Works, Baldwinsville, N.Y.
Morris Co., I. P., Philadelphia, Pa.
Pelton Water Wheel Co., San Francisco, Cal.
Platt Iron Works, Dayton, O.
Rumsey Pump Co., Ltd., Seneca Falls, N.Y.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
United Steam Pump Co., Battle Creek, Mich.
Wilson-Snyder Mfg. Co., Pittsburgh, Pa.
Wood & Co., R. D., Philadelphia, Pa.
Worthington Pump & Machinery Corp'n, New York, N.Y.
—Fire
Cameron Steam Pump Works, A. S., New York, N.Y.
De Laval Steam Turbine Co., Trenton, N.J. *p. 166*
Deming Co., Salem, O.
Fales & Jenks Machine Co., Pawtucket, R.I.
Morris Machine Works, Baldwinsville, N.Y.
Platt Machine Works, Dayton, O.
—Power
Advance Pump & Compressor Co., Battle Creek, Mich.
American Steam Pump Co., Battle Creek, Mich.
Buffalo Steam Pump Co., Buffalo, N.Y.
Cameron Steam Pump Works, A. S., New York, N.Y.
Dayton Pump & Mfg. Co., Dayton, O.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
Deming Co., Salem, O.
Epping-Carpenter Pump Co., Pittsburgh, Pa.
Gardner Governor Co., Quincy, Ill.

Luitwieler Pumping Engine Co., Rochester, N.Y.
Morris Machine Works, Baldwinsville, N.Y.
Novo Engine Co., Lansing, Mich.
Platt Iron Works, Dayton, Mich.
Scranton Steam Pump Co., Scranton, Pa.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
Worthington Pump & Machinery Corp'n, New York, N.Y.

PYROMETERS
—Electric
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Combustion Appliances Co., Chicago, Ill.
Eimer & Amend, New York, N.Y.
Foxboro Co., Foxboro, Mass.
Leeds & Northrup Co., Philadelphia, Pa.
Tagliabue Mfg. Co., C. J., Brooklyn, N.Y.
Taylor Instrument Co's., Rochester, N.Y.
Thwing Instrument Co., Philadelphia, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*

QUILLERS
Foster Machine Co., Westfield, Mass. *p. 117*
Payne, G. W. & Co., Pawtucket, R.I.
Terrell Machine Co., Charlotte, N.C.
Universal Winding Co., Boston, Mass. *p. 118*

REEDS, LOOM
American Supply Co., Providence, R.I.
Emmons Loom Harness Co., Lawrence, Mass.
Knowles Loom Reed Works, New Bedford, Mass.
Schmidt & Co., H. E., New Bedford, Mass.
Steel Heddle Mfg. Co., Philadelphia, Pa.
Whitaker Reed Co., The, Worcester, Mass.

REELS
Draper Corporation, Hopedale, Mass.
Easton & Burnham Machine Co., Pawtucket, R.I.
Whitin Machine Works, Whitinsville, Mass. *p. 103*

REGULATORS
—Damper
American District Steam Co., North Tonawanda, N.Y.
D'Este Co., Julian, Boston, Mass.
Ford Co., Thomas P., New York, N.Y. *p. 168*
Locke Regulator Co., Salem, Mass.
Standard Regulator Co., Newark, N.J.
Watts Regulator Co., Lawrence, Mass.

—Feed Water
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Boston Steam Specialty Co., Boston, Mass.
Foster Engineering Co., Newark, N.J.
Jarvis Engineering Co., Boston, Mass.
Northern Equipment Co., Erie, Pa.
Sorge, Jr. & Co., A., Chicago, Ill.
Tagliabue Mfg. Co., C. J., Brooklyn, N.Y.

—Pressure
American District Steam Co., No. Tonawanda, N.Y.
Brown Instrument Co., Philadelphia, Pa.
Crane Co., Chicago, Ill.
Davis Regulator Co., G. M., Chicago, Ill.
Ford Co., Thomas P., New York, N.Y. *p. 168*
Foster Engineering Co., Newark, N.J.
Ideal Automatic Governor Co., Newark, N.J.
Leslie Co., Lyndhurst, N.J.
Mason Regulator Co., Boston, Mass.
Mueller Mfg. Co., H., Decatur, Ill.
National Regulator Co., New York, N.Y.
Tagliabue Mfg. Co. C. J., Brooklyn, N.Y.
Watts Regulator Co., Lawrence, Mass.

RINGS, SPINNING
Draper Corporation, Hopedale, Mass.
H. & B. American Machine Co., Pawtucket, R.I. *p. 105*
Southern Spindle & Flyer Co., Charlotte, N.C. *p. 112*
Whitinsville Spinning Ring Co., Whitinsville, Mass. *p. 115*

RINGS, TWISTER
Whitinsville Spinning Ring Co., Whitinsville, Mass. *p. 115*

ROLLING MACHINERY
Curtis & Marble Machine Co., Worcester, Mass. *p. 109*
Hunt, Rodney, Machine Co., Orange, Mass. *p. 147*
Parks & Woolson Machine Co., Springfield, Vt. *p. 110*

ROLLS, CALENDER
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 129*
Perkins & Son, Inc., B. F., Holyoke, Mass.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*

ROLLS, FLUTED
Firth, William, Boston, Mass. *p. 107*
H. & B. American Machine Co., Pawtucket, R.I. *p. 105*
Metallic Drawing Roll Co., Indian Orchard, Mass.

ROOFING MATERIALS
Barber Asphalt Paving Co., Philadelphia, Pa.
Barrett Co., The, New York, N.Y.
Certain-teed Products Corp., New York, N.Y.
Penn Metal Co., Boston, Mass.

ROPE
—Transmission
American Mfg. Co., Brooklyn, N.Y.
Columbian Rope Co., Auburn, N.Y.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Hunt Co., Inc., C. W., West New Brighton, N.Y.
Lambeth Rope Corp'n, New Bedford, Mass.
Macomber & Whyte Rope Co., Kenosha, Wis.
Plymouth Cordage Co., North Plymouth, Mass.
St. Louis Cordage Mills, St. Louis, Mo.
Waterbury Co., New York, N.Y.

ROVING MACHINERY
H. & B. American Machine Co., Pawtucket, R.I. *p. 105*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Whitin Machine Works, Whitinsville, Mass. *p. 103*
Woonsocket Machine & Press Co., Woonsocket, R.I.

SASH OPERATING DEVICES
Detroit Steel Products Co., Detroit, Mich.
Drouve Co., G., Bridgeport, Conn.
Hitchings & Co., Elizabeth, N.J.
Lupton's Sons Co., David, Philadelphia, Pa.

SCALES
—Automatic
American Kron Scale Co., New York, N.Y.
Conveying Weigher Co., New York, N.Y.
Howe Scale Co. of N. Y., New York, N.Y.
National Scale Co., Chicopee Falls, Mass.
Richardson Scale Co., Passaic, N.J.
Simmons Co., John, New York, N.Y.
Toledo Scale Co., Toledo, O.

—Conveyer
Electric Weighing Co., New York, N.Y.
Link-Belt, Chicago, Ill.

—Dormant
American Kron Scale Co., New York, N.Y.
Buffalo Scale Co., Buffalo, N.Y.
Fairbanks Co., New York, N.Y.
Jones of Binghamton, Inc., Binghamton, N.Y.
Standard Scale & Supply Co., Pittsburgh, Pa.
Toledo Scale Co., Toledo, O.

—**Platform**
American Kron Scale Co., New York, N.Y.
Buffalo Scale Co., Buffalo, N.Y.
Chatillon & Sons, John, New York, N.Y.
Fairbanks Co., New York, N.Y.
Howe Scale Co. of N. Y., New York, N.Y.
Toledo Scale Co., Toledo, O.

SCHOOLS
—**Textile**
Bradford Durfee Textile School, Fall River, Mass. *p. 189*
Lowell Textile School, Lowell, Mass. *p. 185*
New Bedford Textile School, New Bedford, Mass. *p. 186*
Philadelphia Textile School, Philadelphia, Pa. *p. 187*
Rhode Island School of Design, Providence, R.I. *p. 188*

SCREENS
(See Wire, Woven)

SEPARATORS
—**Oil**
Austin Separator Co., Detroit, Mich.
Baragwanath & Son, Wm., Chicago, Ill.
Boston Steam Specialty Co., Boston, Mass.
Crane Co., Chicago, Ill.
Direct Separator Co., Syracuse, N.Y.
Griscom-Russell Co., New York, N.Y.
Harrison Safety Boiler Works, Philadelphia, Pa.
National Pipe Bending Co., The, New Haven, Conn.
Pittsburgh Valve, Foundry & Const. Co., Pittsburgh, Pa.
Standard Steam Specialty Co., New York, N.Y.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
Webster & Co., Warren, Camden, N.J.
—**Steam**
Anderson Co., V. D. W., Cleveland, O.
Austin Separator Co., Detroit, Mich.
Crane Co., Chicago, Ill.
D'Este Co., Julian, Boston, Mass.
Direct Separator Co., Syracuse, N.Y.
Griscom-Russell Co., New York, N.Y.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Harrison Safety Boiler Works, Philadelphia, Pa.
Hoppes Mfg. Co., Springfield, O.
National Pipe Bending Co., The, New Haven, Conn.
Ohio Blower Co., Cleveland, O.
Pittsburgh Valve, Foundry & Const. Co., Pittsburgh, Pa.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
Webster & Co., Warren, Camden, N.J.

SEWING MACHINES
Dinsmore Mfg. Co., The, Salem, Mass. *p. 123*

SHAFTING
American Tool & Machine Co., Boston, Mass.
Brown Co., A. & F., New York, N.Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Columbia Steel & Shafting Co., Pittsburgh, Pa.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hill Clutch Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Wood's Sons Co., T. B., Chambersburg, Pa.

SHEAVES
—**Rope**
American Pulley Co., Philadelphia, Pa.
Bass Foundry & Machine Co., Fort Wayne, Ind.
Caldwell & Son Co., H. W., Chicago, Ill.
Dodge Sales & Engineering Co., Mishawaka, Ind.
Falls Clutch & Machinery Co., Cuyahoga Falls, O.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Link-Belt Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.
Wellman-Seaver-Morgan Co., Cleveland, O

SHELVING
—**Metal**
Berger Mfg. Co., Cleveland, O.
Bernstein Mfg. Co., Philadelphia, Pa.
Edwards Mfg. Co., Cincinnati, O.
Lupton's Sons Co., David, Philadelphia, Pa.
Manufacturing Equip. & Supply Co., Framingham, Mass.

SHUTTLES
(See also Bobbins, Spools, Shuttles, etc.)
Shambow Shuttle Co., Woonsocket, R.I. *p. 113*
Leigh & Butler, Boston, Mass. *p. 108*

SINGEING MACHINES
Butterworth, H. W., Sons Co., Philadelphia, Pa. *p. 129*
Curtis & Marble Machine Co., Worcester, Mass. *p. 109*
Foster Machine Co., Westfield, Mass. *p. 117*
Hessa, Theodore F., New York, N.Y.
Kump Mfg. Co., C. M., Baltimore, Md.
Phila. Drying Machinery Co., Philadelphia, Pa.
Smith, Drum & Co., Philadelphia, Pa.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*

SIZING, STARCH AND GUMS
American Diamalt Co., New York, N.Y.
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 134*
Bosson & Lane, Atlantic, Mass.
Corn Products Refining Co., New York, N.Y.
Leyland, Thos., Co., Readville, Mass.
Malt-Diastase Co., New York, N.Y.
Morningstar, Chas. & Co., Inc., New York, N.Y.
Seydel Mfg. Co., The, Jersey City, N.J.
Sizing Specialties Co., Jersey City, N.J.
Stein, Hall & Co., New York, N.Y.
Wolf, Jacques & Co., Passaic, N.J.
Worden Chemical Works, New York, N.Y.

SLASHERS AND EQUIPMENT
H. & B. American Machine Co., Pawtucket, R.I. *p. 105*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*
Warp Compressing Machine Co., Worcester, Mass. *p. 111*

SLUBBERS
Woonsocket Machine & Press Co., Woonsocket, R.I.

SOAPS
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 134*
Bosson & Lane, Atlantic, Mass.
Cronkhite Co., The Leonard W., Boston, Mass.
Dobbins Soap Mfg. Co., Philadelphia, Pa.
Draper, J. O., Co., Pawtucket, R.I.
Dunker & Perkins, Boston, Mass.
Electric Smelt. & Alum. Co., Lockport, N.Y.
Fancourt & Co., W. F., Philadelphia, Pa.
Harding, Inc., H. C., Philadelphia, Pa.
Kenney Mfg. Co., F., Boston, Mass.
Rome Soap Co., Rome, N.Y.
Seydel Mfg. Co., The, Jersey City, N.J.
Standard Soap Mfg. Co., Woonsocket, R.I.
Warren Soap Mfg. Co., Boston, Mass.

SODA
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 134*
Ford Co., The J. B., Wyandotte, Mich. *p. 132*

SOFTENERS
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 134*
Bosson & Lane, Atlantic, Mass.
Harding & Fancourt, Inc., Philadelphia, Pa.

Holbrook Mfg. Co., Jersey City, N.J.
Houghton & Co., E. F., Philadelphia, Pa.
Jackson & Co., Ellis, Philadelphia, Pa.
Leyland & Co., Thos., Readville, Mass.
Marston, John P., Boston, Mass.
McMeekan Mfg. Co., David, Brooklyn, N.Y.
Quaker City Chemical Co., Philadelphia, Pa.
Seydel Mfg. Co., The, Jersey City, N.J.
Southern Chemical Laboratory, Chattanooga, Tenn.
Tanner Co., Chas. S., Providence, R.I.
Wolf & Co., Jacques, Passaic, N.J.
Zurn Co., O. F., Philadelphia, Pa.

SPEEDERS
H. & B. American Machine Co., Pawtucket, R.I. *p. 105*

SPINDLES
Atkinson, Haserick & Co., Boston, Mass.
Bamford & Smith, Providence, R.I.
Bodden, Wm. & Sons, Ltd., Providence, R.I.
Buckley's Sons, Benjamin, Paterson, N.J.
Chapman Mfg. Co., Boston, Mass.
Draper Corporation, Hopedale, Mass.
Easton & Burnham Machine Co., Pawtucket, R.I.
Fales & Jenks Machine Co., Pawtucket, R.I.
H. & B. American Machine Co., Pawtucket, R.I. *p. 105*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Southern Spindle & Flyer Co., Charlotte, N.C. *p. 112*
Textile Supply Co., Pawtucket, R.I.

SPINNING FRAMES
Fales & Jenks Machine Co., Pawtucket, R.I.
H. & B. American Machine Co., Pawtucket, R.I. *p. 105*
Mason Machine Works, Taunton, Mass. *p. 106*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Whitin Machine Works, Whitinsville, Mass. *p. 103*
Woonsocket Machine & Press Co., Woonsocket, R.I.

SPINNING TRAVELERS
(See Travelers, Ring)

SPOOLERS
Allen, A. W., Philadelphia, Pa.
Draper Corporation, Hopedale, Mass.
Easton & Burnham Machine Co., Pawtucket, R.I.
Lindsay, Hyde & Co., Philadelphia, Pa.
Payne, George W. & Co., Pawtucket, R.I.
Saco-Lowell Shops, Boston, Mass. *p. 101*
Smith & Furbush Machine Co., Philadelphia, Pa.
Spindler, E. O., New York, N.Y.
Warp Compressing Machine Co., Worcester, Mass. *p. 111*
Whitin Machine Works, Whitinsville, Mass. *p. 103*

SPOOLS
(See Bobbins, Spools, Shuttles, etc.)

SPREADING MACHINERY
Curtis & Marble Machine Co., Worcester, Mass. *p. 109*

SPRINKLER SYSTEMS
Automatic Sprinkler Co. of America, New York, N.Y.
General Fire Extinguisher Co., Providence, R.I.
Globe Automatic Sprinkler Co., Philadelphia, Pa.
Rockwood Sprinkler Co. of Mass., Worcester, Mass.

SPROCKET WHEELS for Valve Operation
Babbitt Steam Specialty Co., New Bedford, Mass. *p. 158*

STACKS
Bigelow Co., The, New Haven, Conn.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass. *p. 167*
Ford, Thomas P., New York, N.Y. *p. 168*
International Engineering Works, Inc., Framingham, Mass. *p. 170*
Rust Engineering Co., New York, N.Y.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn. *p. 171*
Wickes Boiler Co., The, Saginaw, Mich. *p. 172*

STARCHES
Arnold, Hoffman & Co., Inc., Providence, R.I. *p. 134*

STOKERS
American Engineering Co., Philadelphia, Pa.
Casey-Hedges Co., Chattanooga, Tenn.
Combustion Engineering Corp'n, New York, N.Y.
Coxe Traveling Grate Co., Hazleton, Pa.
Detroit Stoker Co., Detroit, Mich.
Greene Engineering Co., East Chicago, Ill.
Illinois Stoker Co., Alton, Ill.
Keystone Stoker Co., Greenfield, Mass.
Laclede-Christy Clay Products Co., St. Louis, Mo.
Lehigh Stoker Co., Fullerton, Pa.
Murphy Iron Works, Detroit, Mich.
Riley Stoker Co., Ltd., Sanford, Worcester, Mass.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
Underfeed Stoker Co. of America, Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*

STRAPS, LUG
Garland Mfg. Co., Saco, Me.
Graton & Knight Mfg. Co., The, Worcester, Mass. *p. 150*
Jacobs Mfg. Co., E. H., Danielson, Conn. *p. 116*

STRIPPERS, CARD
Wm. Firth, Boston, Mass. *p. 107*

SUPERHEATERS, STEAM
Babcock & Wilcox Co., New York, N.Y.
Heine Safety Boiler Co., St. Louis, Mo.
Power Specialty Co., New York, N.Y.

SWEEPERS, BROOMLESS FLOOR
Wm. Firth, Boston, Mass. *p. 107*

TANKS
—**Steel**
Bass Foundry & Machine Co., Fort Wayne, Ind.
Bigelow Co., The, New Haven, Conn. *p. 165*
Coatesville Boiler Works, New York, N.Y.
Dillon Steam Boiler Works, D. M., Fitchburg, Mass. *p. 167*
Heine Safety Boiler Co., St. Louis, Mo.
Hodge Boiler Works, East Boston, Mass.
Hunt Machine Co., Rodney, Orange, Mass. *p. 177*
International Engineering Works, Inc., Framingham, Mass. *p. 170*
Koven & Brother, L. O., Jersey City, N.J.
Mohr & Sons, John, Chicago, Ill.
Phoenix Iron Works Co., Meadville, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa. *p. 175*
Shevlin Engineering Co., Inc., New York, N.Y.
Struthers-Wells Co., Warren, Pa.
Union Iron Works, Erie, Pa.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn. *p. 171*
Washburn & Granger, New York, N.Y.
Wickes Boiler Co., The, Saginaw, Mich. *p. 172*
Wood & Co., R. D., Philadelphia, Pa.

TANKS, TUBS AND VATS
Allen Sons Co., Wm., Worcester, Mass.
Bigelow Company, The, New Haven, Conn. *p. 165*
Biggs Boiler Works, East Akron, O.
Caldwell Co., W. E., Louisville, Ky.
Chicago Bridge & Iron Works, New York, N.Y.

Dillon Steam Boiler Works, D. M., Fitchburg, Mass. *p. 167*
Hall & Sons, Amos H., Philadelphia, Pa.
International Engineering Works, Inc., Framingham, Mass. *p. 170*
New England Tank & Tower Co., Everett, Mass.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*
Tolhurst Machine Works, Troy, N.Y. *p. 126*
Scaife & Sons, W. B., Pittsburgh, Pa. *p. 175*
Stearns, A. T., Lumber Co., Neponset, Mass.
Walsh & Weidner Boiler Co., The, Chattanooga, Tenn. *p. 171*

TAPE
—**Spinning**
Barber Mfg. Co., Lowell, Mass.

TAPE MACHINERY
Barber Mfg. Co., Lowell, Mass.

TAPES, BRAIDS, CORDS AND NARROW FABRICS
American Textile Binding Co., Inc., Philadelphia, Pa.
Gates, T. B. M., New York, N.Y.
Germantown Braid Co., Philadelphia, Pa.
Goff & Sons, D., Pawtucket, R.I.
Hooper Sons Mfg. Co., Philadelphia, Pa.
Industrial Tape Mills Co., Philadelphia, Pa.
Krout & Fite Mfg. Co., Philadelphia, Pa.
Macungie Silk Co., Macungie, Pa.
Small Bros., Fall River, Mass.
Steinthal & Co., M., New York, N.Y.
Street & Co., R. R., Chicago, Ill.
Wright Mfg. Co., Lawrence, Mass.

TELEPHONE SYSTEMS
Automatic Electric Co., Chicago, Ill.
Couch, Inc., S. H., Boston, Mass.
Western Electric Co., New York, N.Y.

TEMPERATURE CONTROLLERS
American Moistening Co., Boston, Mass. *p. 154*
Carrier Engineering Corp., New York, N.Y. *pp. 156–7*
Parks-Cramer Co., Fitchburg, Mass. *pp. 158–9*

TENTERING MACHINES
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 129*

TESTING APPARATUS, FABRIC
Draper Corporation, Hopedale, Mass.
Perkins, B. F. & Son, Inc., Holyoke, Mass.
Precision Instrument Co., Detroit, Mich.
Shuttle Machine Co., New York, N.Y.
Torsion Balance Co., New York, N.Y.

THERMOMETERS
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Combustion Appliances Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Foxboro Co., Foxboro, Mass.
Precision Thermometer & Instrument Co., Philadelphia, Pa.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Standard Thermometer Co., Boston, Mass.
Tagliabue Mfg. Co., C. J., Brooklyn, N.Y.
Taylor Instrument Co's., Rochester, N.Y.

THREAD, METAL
Montgomery Co., J. R., Windsor Locks, Conn. *p. 135*

TIME RECORDERS
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Cincinnati Time Recorder Co., Cincinnati, O.
Howard Clock Co., The E., Boston, Mass.
International Time Recording Co., Endicott, N.Y.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N.Y.
Simplex Time Recorder Co., Gardner, Mass.
Stromberg Electric Co., Chicago, Ill.

TINSEL, COTTON
Montgomery Co., J. R., Windsor Locks, Conn. *p. 135*

TRADEMARKING MACHINERY
Curtis & Marble Machine Co., Worcester, Mass. *p. 109*
Parks & Woolson Machine Co., Springfield, Vt. *p. 110*

TRAPS
—**Steam**
Albany Steam Trap Co., Albany, N.Y.
American Blower Co., Detroit, Mich.
Anderson Co., V. D. N., Cleveland, O.
Automatic Steam Trap & Specialty Co., Cleveland, O.
Crane Co., Chicago, Ill.
D'Este Co., Julian, Boston, Mass.
Lytton Mfg. Corp'n, Franklin, Va.
Morehead Mfg. Co., Detroit, Mich.
Nashua Machine Co., Nashua, N.H.
Nason Mfg. Co., New York, N.Y.
Ohio Blower Co., Cleveland, O.
Pittsburgh Valve, Foundry & Const. Co., Pittsburgh, Pa.
Pratt & Cady Co., Inc., Hartford, Conn.
Sarco Company, Inc., New York, N.Y.
Simmons Co., John, New York, N.Y.
Sturtevant Co., B. F., Boston, Mass.
Webster & Co., Warren, Camden, N.J.

TRAVELER CLEANERS
Whitinsville Spinning Ring Co., Whitinsville, Mass. *p. 115*

TRAVELERS, RING
National Ring Traveler Co., Providence, R.I.

TRUCKS
Barrett-Cravens Co., Chicago, Ill.
Clark Co., Geo. P., Windsor Locks, Conn.
Cowan Truck Co., Holyoke, Mass.
Diamond State Fibre Co., Bridgeport, Pa.
Elwell-Parker Electric Co., Cleveland, O.
Fairbanks Co., Boston, Mass.
Lakewood Engineering Co., Cleveland, O.
Lewis-Shepard Co., Boston, Mass.
National Scale Co., Chicopee Falls, Mass.
Stuebing Truck Co., Cincinnati, O.

TUBE CLEANERS, BOILER
Chesterton Co., A. W., Boston, Mass.
Lagonda Mfg. Co., Springfield, O.
Monarch Steam Blower Co., Troy, N.Y.
Pierce Co., Wm. B., Buffalo, N.Y.
Roto Co., Hartford, Conn.
Spencer Turbine Cleaner Co., Hartford, Conn.

TUBE WINDERS
Foster Machine Co., Westfield, Mass. *p. 117*

TUBES FOR WINDING
Universal Winding Co., Providence, R.I. *p. 118*

TUBING MACHINES
—**Rubber**
Royle & Sons, John, Paterson, N.J. *p. 127*

TURBINES
—**Hydraulic**
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Holyoke Machine Co., Holyoke, Mass.
Hunt Machine Co., Rodney, Orange, Mass. *p. 147*

Hydraulic Turbine Corp'n, Camden, N.J.
Leffel & Co., James, Springfield, O.
Pelton Water Wheel Co., San Francisco, Cal.
Platt Iron Works, Dayton, O.
Smith Co., S. Morgan, York, Pa.
Wellman-Seaver-Morgan Co., Cleveland, O.

—Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
De Laval Steam Turbine Co., Trenton, N.J. *p. 166*
General Electric Co., Schenectady, N.Y. *p. 161*
Kerr Turbine Co., Wellsville, N.Y.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Sturtevant Co., B. F., Boston, Mass.
Terry Steam Turbine Co., The, Hartford, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*

TURBO-BLOWERS
Coppus Engineering & Equipment Co., Worcester, Mass.
De Laval Steam Turbine Co., Trenton, N.J. *p. 166*
General Electric Co., Schenectady, N.Y. *p. 161*
Ingersoll-Rand Co., New York, N.Y.
Kerr Turbine Co., Wellsville, N.Y.
Power Turbo-Blower Co., New York, N.Y.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*
Worthington Pump & Machinery Corp'n, New York, N.Y.

TURBO-PUMPS
Coppus Engineering & Equipment Co., Worcester, Mass.
De Laval Steam Turbine Co., Trenton, N.J. *p. 166*
Kerr Turbine Co., Wellsville, N.Y.
Morris Machine Works, Baldwinsville, N.Y.
Platt Iron Works, Dayton, O.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
Terry Steam Turbine Co., The, Hartford, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*
Wheeler Condenser & Engineering Co., Carteret, N.J.

TWINE
(See also Paper and Twine)
Greene Paper Co., R. L., Providence, R.I. *p. 148*
Universal Winding Co., Providence, R.I. *p. 118*

TWISTING MACHINERY
Draper Corporation, Hopedale, Mass.
Fales & Jenks Machine Co., Pawtucket, R.I.
Haskell-Dawes Machine Co., Boston, Mass.
H. & B. American Machine Co., Pawtucket, R.I. *p. 105*
Saco-Lowell Shops, Boston, Mass. *p. 101*
Smith & Furbush Machine Co., Philadelphia, Pa. *p. 121*
Whitin Machine Works, Whitinsville, Mass. *p. 103*

TWISTING TRAVELERS
(See Travelers, Ring)

TYING MACHINES, WARP
Barber-Colman Co., Rockford, Ill. *p. 122*

UNIONS
Crane Co., Chicago, Ill.
Dart Mfg. Co., Providence, R.I.
Jefferson Union Co., Lexington, Mass.
Walworth Mfg. Co., South Boston, Mass.

VALVE OPERATING MECHANISM
Babbitt Steam Specialty Co., New Bedford, Mass. *p. 139*

VALVES
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Coffin Valve Co., Neponset, Mass.
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Darling Pump & Mfg. Co., Ltd., Williamsport, Pa.
Dole Valve Co., Chicago, Ill.
Eddy Valve Co., Waterford, N.Y.
Homestead Valve Mfg. Co., Pittsburgh, Pa.
Jenkins Bros., New York, N.Y.
Kelly & Jones Co., Greensburg, Pa.
Kennedy Valve Mfg. Co., Elmira, N.Y.
Ludlow Valve Mfg. Co., Troy, N.Y.
Lunkenheimer Co., The, Cincinnati, O.
McNab & Harlin Mfg. Co., New York, N.Y.
Marsh Valve Co., Erie, Pa.
Morris Machine Works, Baldwinsville, N.Y.
Nelson Valve Co., Philadelphia, Pa.
Ohio Brass Co., Mansfield, O.
Pittsburgh Valve & Fittings Co., Barberton, O.
Pittsburgh Valve, Foundry & Const. Co., Pittsburgh, Pa.
Powell Co., William, Cincinnati, O.
Pratt & Cady Co., Inc., Hartford, Conn.
Simmons Co., John, New York, N.Y.
Starkweather & Broadhurst, Boston, Mass. *p. 173*
Walworth Mfg. Co., South Boston, Mass.
Wheeler Mfg. Co., C. H., Philadelphia, Pa.
Wood & Co., R. D., Philadelphia, Pa.

VARNISHES
(See Paints)

VENTILATING APPARATUS
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N.Y. *p. 155*
Carrier Engineering Corp., New York, N.Y. *pp. 156–7*
Sturtevant Co., B. F., Boston, Mass.

VOLTMETERS
Biddle, James G., Philadelphia, Pa.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
General Electric Co., Schenectady, N.Y. *p. 161*
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. *p. 162*

WARP COMPRESSORS
Warp Compressing Mch. Co., Worcester, Mass. *p. 111*

WARP STOP MOTIONS
Crompton & Knowles Loom Wks., Worcester, Mass. *p. 102*
Draper Corporation, Hopedale, Mass.
Firth, William, Boston, Mass. *p. 107*

WARPERS
(See Beaming and Warping Machinery)

WARPS, COTTON
Montgomery Co., J. R., Windsor Locks, Conn. *p. 135*

WASH ROOM EQUIPMENT
Manufacturing Equip. & Engrg. Co., Framingham, Mass.
Mott Iron Works, J. L., Trenton, N.J.
Speakman Supply and Pipe Co., Wilmington, Del.
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

WASHERS (Cloth)
Buhlmann, A. W., New York, N.Y.
Butterworth & Sons Co., H. W., Philadelphia, Pa. *p. 120*
Hunt Machine Co., Rodney, Orange, Mass. *p. 117*
Hunter Machine Co., James, North Adams, Mass.

Jefferson, Edward, Philadelphia, Pa.
Philadelphia Drying Machinery Co., Philadelphia, Pa.
Street & Co., R. R., Chicago, Ill.
Textile-Finishing Machinery Co., The, Providence, R.I. *p. 114*

WASTE RECLAIMING MACHINERY
Saco-Lowell Shops, Boston, Mass. *p. 101*
Whitin Machine Works, Whitinsville, Mass. *p. 103*

WATER PURIFYING PLANTS
Detroit Steam Appliance Co., Detroit, Mich.
Harrison Safety Boiler Works, Philadelphia, Pa.
Hungerford & Terry, Inc., Philadelphia, Pa.
International Filt r Co., Chicago, Ill.
Loomis-Manning Filter Distributing Co., Philadelphia, Pa.
New York Continental Jewell Filtration Co., New York, N.Y.
Permutit Co., New York, N.Y.
Pittsburgh Filter Mfg. Co., Pittsburgh, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa. *p. 175*
Starkweather & Broadhurst, Boston, Mass. *p. 173*

WATER SOFTENERS
American Water Softener Co., Philadelphia, Pa.
Dearborn Chemical Co., Chicago, Ill.
Detroit Steam Appliance Co., Detroit, Mich.
Harrison Safety Boiler Works, Philadelphia, Pa.
Industrial Filter Co., Chicago, Ill.
Michigan Engineering Co., Detroit, Mich.
Permutit Co., New York, N.Y.
Refinite Co., Des Moines, Ia.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa. *p. 165*
Solvay Power Co., New York, N.Y. *p. 176*
Starkweather & Broadhurst, Boston, Mass. *p. 173*

WATER WHEELS
(See Turbines, Hydraulic)

WHEELS, SPROCKET, FOR VALVES
Babbitt Steam Specialty Co., New Bedford, Mass. *p. 139*

WINDERS
Allen, A. W., Philadelphia, Pa.
Altemus, J. K., Philadelphia, Pa.
Crompton & Knowles Loom Works, Worcester, Mass. *p. 102*
Easton & Burnham Machine Co., Pawtucket, R.I.
Firth, William, Boston, Mass. *p. 107*
Foster Machine Co., Westfield, Mass. *p. 117*
General Processing Co., Philadelphia, Pa.
Grosser Knitting Machine Co., New York, N.Y.
Jefferson, Edward, Philadelphia, Pa.
Leigh & Butler, Boston, Mass. *p. 108*
Lever Co., Inc., Oswald, Philadelphia, Pa.
Lindsay, Hyde & Co., Philadelphia, Pa.
Payne Co., Geo. W., Pawtucket, R.I.
Pratt, Robert G., Worcester, Mass.
Saco-Lowell Shops, Boston, Mass. *p. 101*
Smith & Furbush Machine Co., Philadelphia, Pa. *p. 121*
Spindler, E. O., New York, N.Y.
Universal Winding Co., Boston, Mass. *p. 118*
Windle, J. E., Worcester, Mass.

WINDERS AND DOUBLERS, CLOTH
Curtis & Marble Machine Co., Worcester, Mass. *p. 109*
Foster Machine Co., Westfield, Mass. *p. 117*
Parks & Woolson Machine Co., Springfield, Vt. *p. 110*
Windle, J. E., Worcester, Mass.

WINDOWS
Metal
Badger & Sons, E. B., Boston, Mass.
Drouve Co., G., Bridgeport, Conn.
Detroit Steel Products Co., Detroit, Mich.
Lupton's Sons Co., David, Philadelphia, Pa.

WIRE, WOVEN
Clinton Wire Cloth Co., Clinton, Mass.
Morss & Whyte Co., The, Cambridge, Mass.
Page Steel & Wire Co., Adrian, Mich.
Wright Wire Co., Worcester, Mass.

WIRES AND CABLES, ELECTRICAL
American Brass Co., Waterbury, Conn.
American Steel & Wire Co., Chicago, Ill.
Electric Cable Co., The, New York, N.Y.
General Electric Co., Schenectady, N.Y. *p. 161*
Habirshaw Electric Cable Co., New York, N.Y.
Simplex Wire & Cable Co., Boston, Mass.
Western Electric Co., Inc., New York, N.Y.

YARD NUMBERING MACHINERY
Parks & Woolson Machine Co., Springfield, Vt. *p. 110*

YARNS, COTTON
Catlin & Co., New York, N.Y.
Eastern Yarn Co., Boston, Mass.
Gate City Cotton Mills, Atlanta, Ga.
Hamburger Cotton Mills, Columbus, Ga.
Hawes & Bro., O. S., Fall River, Mass.
Hofmann & Ellrodt, Inc., New York, N.Y.
Holmes Mfg. Co., New Bedford, Mass.
Hooper Sons Mfg. Co., Philadelphia, Pa.
Johnston Mfg. Co., Philadelphia, Pa.
Lings & Co., G. S., New York, N.Y.
Littauer & Co., Inc., Ludwig, New York, N.Y.
Manley & Johnson, New York, N.Y.
Miller & Co., H. K., Boston, Mass.
Mitchell Co., James E., Philadelphia, Pa.
Montgomery Co., J. R., Windsor Locks, Conn. *p. 135*
Monument Mills, Housatonic, Mass.
Orswell Mills, Fitchburg, Mass.
Paulson, Linkroum & Co., New York, N.Y.
Plowman & Co., C. M., Philadelphia, Pa.
Quisset Mill, New Bedford, Mass.
Robison & Son, Inc., G., New York, N.Y.
Salkeld & Bro., Inc., A. D., New York, N.Y.
Simons, H. F., New York, N.Y.
Street & Co., John F., Providence, R.I.
Turner Co., J. Spencer, New York, N.Y.
Webb Co., Chas. J., Philadelphia, Pa.
Whitmore Co., R. D., New York, N.Y.

Date Loaned

Standard cotton mill
practice and equipment